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Veterinary Service at an Army Post*

By D. M. CAMPBELL, Lt. Col., V.C.

Various discussions of army veterinary service during the present war have appeared in veterinary periodicals,[1-14] but none[15] have discussed the routine work of the veterinary detachments of forts, camps, fields, schools and other military installations of the Army Service Forces, although the number of veterinarians in this "camp overhead" branch of the Army is greater than in either the Army Ground Forces or the Army Air Forces. Furthermore most newly commissioned veterinary officers are assigned to this post or station service for a period of "seasoning" before going to tactical organizations. Inasmuch as the same is true of the enlisted personnel of the veterinary service the "labor turnover" in station veterinary service is rapid. Thus, it will be seen that the majority of the veterinary personnel of the Army, for at least a part of its first year in the military service, is assigned to the veterinary detachment of some fort, camp, airfield or other station.

Since some readers may not be fully informed as to just what niches in the big picture are occupied by the veterinary service of the Army, it may be permissible to mention that the Army is divided on functional lines into three main branches—the Army Ground Forces (AGF), Army Air Forces (AAF), and the Army Service Forces (ASF). The first two of these divisions are combat organizations; the ASF is exclusively a supply organization. In the Army of 1917-1918, it was known as the Service of Supply (S O S). It is mainly with the

*Received for publication Oct. 31, 1943.

[1] Inspection of meat, meat foods and dairy products consumed by the Army, *Jnl. A. V. M. A.*, 100:781, pp. 301-04 (April, 1942).

[2] The school of meat and dairy hygiene, *Vet. Med.*, 37:6, p. 234 (June, 1942).

[3] Veterinary Officers at Medical Field Service School, *Vet. Med.*, 37:6, p. 240 (June, 1942).

[4] Functions of the Army veterinary service, *Vet. Med.*, 37:7, pp. 281-85 (July, 1942).

[5] Experiences in an Army Veterinary General Hospital, *Vet. Med.*, 37:8, pp. 326-38 (August, 1942).

[6] Veterinary service of a pack train, *Vet. Med.*, 37:10, pp. 421-23 (October, 1942).

[7] Chemical warfare; its effects on Army animals, *Vet. Med.*, 37:9, pp. 358-61 (September, 1942).

[8] Treatment of wounds in army animals, *Vet. Med.*, 37:11, pp. 463-69 (November, 1942)

[9] Communicable disease problems, *Vet. Med.*, 37:12, pp. 495-96 (December, 1942).

[10] Veterinary officers attend Medical Field Service School, *Vet. Med.*, 38:2, p. 43 (February, 1943).

[11] Army meat and food inspection, *Vet. Med.*, 38:3, p. 82 (March, 1943).

[12] Inspection of meat for the U. S. Army, *Vet. Med.*, 38:4, pp. 127-29 (April, 1943)

[13] Veterinary officer's successful fat salvage plan, *Vet. Med.*, 38:7, p. 242 (July, 1943).

[14] Icelanders appreciate aid of American veterinarians, *Jnl. A. V. M. A.*, 103:798, pp. 170-74 (September, 1943).

[15] Various discussions, chiefly of products inspection, have appeared in the Army *Veterinary Bulletin* but since that publication, now discontinued, was restricted in distribution the information contained in the discussions is not generally available.

veterinary service of this supply organization that this discussion is concerned.

Each of these Forces has its own medical, dental, veterinary and many other services which are independent of the analogous services in the other Forces. The duties of the veterinary services differ somewhat in the different Forces. Thus, the veterinary service of the AGF trains with the troops at the various forts, camps, etc., in this country and proceeds overseas with them to the war zones where it inspects the food of animal origin as it is received from the transport service, during storage and at issue to the troops.

In organizations that possess animals, the veterinary service establishes veterinary aid stations, dispensaries and hospitals and evacuates and treats disabled animals. It is responsible also for initiating hygienic and sanitary measures to protect the animals of the Army and animals of the civilian population of occupied zones, from disease. In fact, for initiating all measures to conserve the animal strength of the command.

The veterinary service of the Army Air Forces parallels that of the AGF.*

The Army Service Forces build and maintain forts and camps at which the combat organizations are trained, and procure the food, clothing, guns, airplanes, ammunition and other supplies required by them. The ASF also transports and delivers these supplies to the combat organizations both in this country and overseas; and, of course, for its own personnel as well. It is largely in this procurement, packaging, storing and shipment of food supplies that the veterinary service of the ASF is employed. It also operates veterinary dispensaries and veterinary hospitals at stations where there are army animals.

The discussion of veterinary sanitary inspection in the following pages pertains exclusively to the work of the veterinary service of the ASF at forts, camps and other stations in this country. It is just one phase, of one of many services, performed by the Veterinary Corps of the Army. As opportunity offers, other services of the Corps may be discussed, in these pages, later.

Officers assigned to veterinary detachments in forts, camps, airfields and other stations, like officers of other services, are given various special duties in addition to their primary duties. Such special duties include those of officer of the day, survey officer, mess officer, farms' officer, garden officer, member of courts martial, member of Section VIII boards, mosquito control officer, sanitary inspector, equitation instructor, theatre officer and many other duties deemed necessary to the military service by the commanding officer of the post.

The veterinary service of a fort, camp or other military post is usually designated the station veterinary detachment. Officially it is the Veterinary Service of the Medical Section of the numbered service unit of which it is a part. It comprises a Station Veterinarian (the senior veterinary officer on duty in the station overhead) and from two to thirty or more commissioned and enlisted assistants, depending upon the size of the station and the number of point of origin inspections outside the post. In a station veterinary detachment the enlisted personnel usually constitute about two-thirds of the detachment; the officers about one-third. This refers to the station complement (overhead) only and is exclusive of any veterinary personnel assigned to tactical organizations that may be training at the post.

Since any description of all the duties of a station veterinary service would extend to undue length, this discussion will be limited, in the main, to the sanitary inspection of plants processing foods of animal origin for the Army. That function of the Army veterinary service is, perhaps, less familiar to the profession in general than is food products' inspection.

The sanitary regulations with which a station veterinary service is concerned are of three classes: (1) those having to do with animals on the post, their use, care and housing, (2) those pertaining to the transportation, storage and issue of food on the post and (3) the sanitation of establishments off the post from which the army purchases food supplies of animal origin.

*Because of the nature of its missions the AAF is somewhate more self-contained than the AGF, and its veterinary service performs some of the functions that are performed for the AGF by the veterinary service of the ASF.

The latter includes principally meat packing plants, creameries, evaporated milk plants, powdered milk plants, cheese factories, fluid milk plants, ice cream plants, dairy farms, poultry slaughtering, dressing and distributing establishments, establishments handling shell, frozen and powdered eggs, wholesale fish markets, other sea food establishments and various types of refrigeration plants.

The chief objective of sanitary inspection of food processing plants is improvement of the palatability of the foods. After safety, nothing, not even nutrition, is as important as palatability, flavor, or acceptability of foods, for soldiers. The safety of foods is generally assured by sterilization, pasteurization or cooking, but whatever the care exercised in acquiring the food, assuring its safety, planning the ration and preparing the meal; all are to no purpose if the food is not eaten. Soldiers are well-fed at posts and do not have the urge of hunger to induce them to eat food that they do not relish. Unpalatable food set before them is largely wasted food. Foods that violate the soldier's esthetic standards are likewise uneaten. On one occasion a practical joker, near the head of a line of soldiers who were filing by the serving table, told the man next to him that horse meat was being served that day. The word passed all down the line and more than half of the whole unit of nearly 400 men refused as fine roast beef as one could wish to see. If cooks or kitchen police note anything of unsavory appearance about the food they are preparing, the whole organization usually knows it before mealtime. If the soldier didn't know that his food is inspected, not once but many times, before he gets it, it is hard to imagine what tales about it he would hear and, at least, partially believe.

All foods are eaten by greater number of soldiers and with more relish if free from flavors imparted by gross bacterial or other contamination during production and processing. Hence, sanitary inspection of food processing plants and supervision of food manufacture assume major importance in the nutrition of the soldier; inspection is not only a potent factor in preventing the waste of food, but is an important economic measure, also.

The present policy of purchasing food for

Fig. 1. Brigadier General R. A. Kelser, Director, Veterinary Division, Surgeon General's Office and other officers of the Army Veterinary Corps, meet with Chicago Packers to discuss the preparation and packaging of food products for the Army. Left to right (seated): A. A. Dacey and H. J. Williams, Wilson & Co., Brig. Gen. Kelser; (standing) Col. Fred C. Waters, Depot Veterinarian, Chicago Quartermaster Depot, Drs. H. E. Kingman and R. F. Vermilya, Wilson & Co., Col. Seth C. Dildine, Headquarters Veterinarian, Quartermaster Perishable Subsistence Branch, Col. James E. Noonan, Veterinarian, Sixth Service Command, G. B. Thorne, Wilson & Co., Col. Louis L. Shook, Director Army School of Meat and Dairy Hygiene, Harold Graham, Wilson & Co. The photographs from which this and all other illustrations in this discussion, except Figs. 4, 32, 33 and 34, were made by the Signal Corps, U. S. Army

the Army from the processing plants, instead of at the central markets, throws a great amount of "point of origin" inspection onto the veterinary detachments of posts in states where the poultry and dairy products used by the Army are largely produced. In order to hold the cost of travel at a minimum, each station handles the inspections originating nearest to it. Sometimes that includes all the creameries, cheese factories, poultry and egg plants, etc., that supply the Army in a whole state. In the main, beef, pork and lamb, now as formerly, are inspected at the great packing centers and the veterinary service of army posts inspects them only for the condition of the products at the time of arrival. But with "point of origin" inspection everything must be considered, including quality and wholesomeness of the raw material used, sanitary condition, methods of processing, quality, type, grade, class, packaging and shipping. In addition, the equipment and sanitary condition of the plant in which the food is processed is a responsibility of the inspector.

The enlisted personnel in the station veterinary service is selected (except at stations where there are large numbers of animals) from soldiers who have had an extensive experience in meat, dairy and produce fields and have become thoroughly familiar with commercial grades and grading, and methods of processing and packaging meat, dairy and poultry products. In addition, the men selected are given courses of instruction lasting from four to 13 weeks in army veterinary technician schools. After an experience of a few months in a station veterinarary detachment, many of them are transferred to combatant or other field organizations, usually in the non-commissioned grades.

Veterinary officers come into the military service from a wide variety of civilian activities—from general practice, from small animal practice, from B.A.I. service, from state livestock sanitary service, from state and municipal health services, from laboratories, schools and commercial fields. All have a good foundation in food inspection derived from their college course on the subject, but differing experiences has led to wide differences in skills. The general practitioners take readily to milk sanitation. None other can secure such ready and complete cooperation from the dairymen and any lack of familiarity with the methods of processing milk is soon remedied. While the pathological faults of meats may be an

FIG. 2. VETERINARY OFFICERS CLASS, MEDICAL FIELD SERVICE SCHOOL
As rapidly as circumstances permit, newly commissioned veterinary officers are given a six weeks' course of instruction at the Medical Field Service School at Carlisle Barracks, Pennsylvania, and at the Army School of Meat and Dairy Hygiene at Chicago

open book to them, the packers' grades, the O.P.A. grades, the FDA grades and the Army's grades may be confusing for weeks. Poultry, fish, oysters, shrimp and a dozen varieties of cheese may test not only the knowledge of the officer from the field of general practice, but his resourcefulness and his ability to learn quickly; for he must determine not only the wholesomeness of these products but the quality, the way they have been processed, stored and transported, in short—their compliance with specifications. On the other hand, the newly commissioned veterinary officer with a federal meat inspection background is highly expert in the field of meat and meat products. Grades are an old story to him in carcass, cured and canned meats. By contrast scoring butter or instituting sanitary methods in a pasteurizing plant, or in a cheese factory may require a short period of training. On the farm the dairyman may catalogue him "policeman" and close up like a clam. And so it is with men from every branch of civilian veterinary service; military veterinary service is likely to entail responsibilities with which they are more or less unfamiliar and engender not a few headaches.

The Station Veterinarian is usually a major or a lieutenant colonel, or at some small stations a captain. A part of his duties is to train his junior officers in the duties incident to the veterinary service of the station and in military courtesies, customs and duties. At the end of a six months' assignment to his station he must render to higher authority an account of his stewardship of each junior officer, including a statement of the capacity of each to handle greater responsibility and if their training is not such as to justify this, why it is not. Thus it will be seen that a new officer is seldom kept for more than a few weeks at the same task. The station veterinarian must transfer him from one job to another every few weeks so that he may become familiar with all within a reasonable time. An officer of average intelligence, who is industrious, applies himself and has fair opportunities, should be able at the end of a year to handle the work of a small station acceptably. Many have had to do it with much less experience and have done a good job; but it is hardly fair to the officer to expect it of him.

Veterinary sanitary reports should be accurate, of course, but a good deal more than simple accuracy is needed. They should be fair, both to the government and to the owners of the plant inspected, and they should be comprehensive without including unnecessary matters. The need for the changes, if any are recommended, should

FIG. 3. EARLY CLASS OF VETERINARY OFFICERS AT ARMY SCHOOL OF MEAT AND DAIRY HYGIENE
The course at this school extends over a period of 40 days. Much of the instruction is by means of demonstrations in the great Chicago packing houses, milk plants and cold storage houses and in the central poultry and egg markets. By the end of 1943 more than 700 veterinary officers had taken the course

be fully justified by the description of the building, equipment or practices. The report should be so written that higher authority can form an accurate conclusion as to the plant and processes without additional explanation. Any equipment or practice that is disapproved should be described very clearly. Matters that are satisfactory may be covered in less detail but all equipment and methods, which influence the sanitary condition of the product to an important degree, should be mentioned to indicate that it has not been overlooked and also as a matter of fairness to the owner of the plant. This necessitates a systematic plan for the inspection and a logical sequence in the report. Naturally a sanitary inspection of a factory where fruit syrups and flavoring extracts are made (for use in ice cream) will differ from that of a cheese factory or a powdered egg plant. It is to be expected also that reports from different inspectors will differ in details but the general plan can be the same. At places in this discussion copies of routine sanitary reports by different inspectors are included—not as models but as samples of reports that give adequate information concerning the plant inspected without unnecessary detail or verbosity. The writer has used the following outline with satisfaction in preparing a sanitary report of a food processing plant. It entails a little more work than a report like the sample (page 62) that starts with the raw material as it enters the plant and follows it through to the finished products, but the outline follows a rather more logical procedure.

Outline for Sanitary Report

SUBJECT:
TO:
ESTABLISHMENT:
ADDRESS:

1. General.
   a. Scope of Business.
   b. Procurement.
2. Building.
   a. Premises.
   b. Construction.
      (1) Exterior.
      (2) Interior (arrangement).
         (a) Walls.
         (b) Ceilings.
         (c) Floors.
         (d) Drains.
         (e) Ventilation.
         (f) Lighting.
         (g) Screens (seasonal).
3. Public Health Aspects.
   a. Water supply.
   b. Sewage disposal.
   c. Hand washing facilities.
   d. Toilets and locker rooms.
   e. Refrigeration.
   f. Fly and vermin control.
4. Equipment.

Fig. 4. Many of the operations in all plants manufacturing dairy products correspond closely, since milk is the raw material from which all are derived. Cleanliness is an essential all the way through the various processes, from the dairy barn to the consumers' table

a. Equipment in use (condition, repair, cleanliness).
b. Efficiency of operation.
5. Plant sanitation.
a. Daily cleaning operations.
b. General cleanliness of establishment (walls, floors, etc.).
6. Unsanitary Practices.
a. Violations of sanitary regulations.
b. Other unsanitary operations.
7. Recommendations.

(These should be very specific and definite. They are usually divided into changes desirable and changes that are essential).

The accompanying illustrations, together with the discussion of different types of food processing plants, indicate briefly the general plan of operation and critical steps in the processing from a sanitary point of view.

The Dairy Industry

The dairy farm and the fluid milk plant complete their entire cycles 365 times a year; i.e., they experience a complete turnover of their merchandise daily. Whereas the grain farmer harvests his crops once a year, the dairy farmer must harvest his crop 730 times, and market it up to 365 times, per year. On the whole more labor is employed in dairying than in any other type of agriculture. With these facts in mind, it is easy to realize the complexity of the problems that arise in the procurement, manufacturing and marketing of the produce of our dairy industry, the products of which include our most essential and most nutritious foods. It is an industry primarily vital to the health and growth of children and also the means of supplying our adult population with a variety of pleasing, palatable and highly nutritious foods.

In an emergency, such as an armed conflict, food must be supplied in enormous quantities to meet the ever increasing demand of a people at war. Increased demand at such a time is due to several factors, among which is the fact that the average soldier living under rigorous army routine consumes about one-third more food than does the same individual in civilian life. To meet this demand the dairy industry, both on the farms and in the processing plants, must operate at a production level far above its normal capacity.

At best, the industry needs strict sanitary supervision at all times because of the nature of the product. Operating at the limit of its capacity, under an acute shortage of labor and with equipment that cannot be replaced easily as it wears out or becomes obsolescent, intensifies the need for maintenance of rigid sanitary precautions.

In any circumstance, the responsibility of the inspecting officer is great. Under conditions that exist in the industry during war, it is doubled, especially when the products are destined for the armed forces and must meet the requirements that govern the quality of all army food.

It is not easy to increase the production of dairy products on a large scale without adequate preparation, as milk is a product that must be handled under ideal conditions if it is to comply with the standard set by the Army. For the veterinary inspector who must see that these sanitary regulations are maintained, there are certain definite factors to take into consideration. If he is not a specialist in this line he should orient himself with the scope of the field and a full realization of the problems with which he is to deal. Only if he understands the situation can he apply the fundamental, basic conception of sanitation with which, of course, he is familiar. A knowledge of the different processes is desirable because it helps to further the understanding that is necessary to enforce sanitary regulations.

Obviously the war cannot be won without adequate food, therefore, the dairy industry becomes a production line, as vital as those producing military equipment; consequently, rigid enforcement of sanitary regulations for the processing should be maintained. By this means only can the quality of the product be assured and the health and well being of the armed forces be protected from the injurious effects of unwholesome or unnutritious food.

General Considerations in Dairy Plant Inspection

Dairy plant inspection presupposes the ability of the inspector to understand the conditions he observes and determine whether or not they comply with army standards of sanitation.

In all dairy manufacturing plants which use milk as the raw material, many of the operations correspond closely. There are certain factors in plant sanitation that apply equally to all of them. Cleanliness is the first and most important requirement of sanitation. From a sanitary standpoint, a high quality product cannot be produced in any establishment which does not enforce rigid standards of cleanliness.

Dairy inspection may be divided into two principal classes: (1) establishment, or plant (including dairy farm) inspection and (2) products inspection. The purpose of the former is to see that sanitary methods are employed; the second to determine the safety and quality of the product itself. In most instances the condition of the establishment is a major factor in the quality of the finished product; however, this discussion will be limited to plant inspection.

Although detailed instructions for the sanitary production of dairy products are given in the U. S. Public Health Service milk code, the inspector must rely on his own judgment as to their application. A bright, shiny surface is far more apt to be clean physically and bacteriologically than one which is pitted, rusted, or to which accumulations from previous use adhere. A general understanding of processes and equipment is all the special information needed by veterinary officers to make a comprehensive inspection. A knowledge of bacteriology, pathology and sanitation on his part is assumed, as is also a cultivated esthetic standard.

In general, all dairy products plants are similar. All processes embody the regulation of temperatures at various steps in the manufacture, either for the control of bacterial growth or to change the physical characteristics of the product. The fact that there is only one basic raw material explains the similarity in plants, equipment and methods of handling.

Observation of the building which houses the establishment and the surrounding area constitutes the first step in any plant inspection. An attractive building amid pleasant surroundings usually portends a clean, well operated plant. This is not true invariably—but there are few exceptions.

The structure of the building itself plays an important role in sanitary operation. If the walls and floors are of wood construction, it is not well suited for a milk processing plant. Since wood absorbs moisture from the very humid atmosphere common in milk plants, it creates an ideal place for the growth of bacteria and molds. This may not seem important as milk does not come in contact with the walls, but a plant that has become infested with mold growth must sometimes be completely treated with disinfectant material, if a sanitary product is to be produced in it. Molds and bacteria may be air-borne and if present in large numbers anywhere in the plant, they will eventually find their way into the product. Furthermore, condensed moisture dripping from the ceiling can, and does, contaminate utensils.

Good construction need not be attractive, but it may well be so. The following points are considered essential: The building should be preferably of brick, stone, tile, concrete or other impervious material, in reasonably good condition. It should be clean, well lighted and properly designed for its purpose. However if wooden construction is used, the walls and ceiling should be coated heavily with clean paint. In the case of a plant bottling fluid milk, the arrangement of rooms should comply with the requirements of the U. S. Public Health Service milk code.

The design and general construction of the building is secondary in importance to the construction of the walls and floors of the separate rooms. Floors should be smooth and well pitched to insure quick and complete drainage. They should be constructed

of some impervious material and be free from cracks and depressions where water may collect. Rough, or cracked floors cannot be easily nor completely cleaned. They harbor molds, and bacterial and organic material lodged in the abrasions give rise to offensive odors.

Of scarcely less importance are the ceilings which also should be smooth and water resistant. Tile or other impervious material that is easily washable make excellent ceiling coverage. In the case of plaster, it should be well painted with a water resistant paint to insure ease of washing. There should be no cracking and peeling of the surfaces. It is not only unsightly, but may be harmful, as well, to the product being manufactured.

Ventilation plays an important part in the maintenance of good walls and ceilings. The atmosphere of a milk plant, or any milk processing establishment, may frequently be filled with steam. If no provision is made to eliminate this excess moisture, condensation on the walls and ceilings is inevitable. This not only allows a constant drip from the walls and ceilings but also damages and shortens the life of the paint. Exhaust fans and dry air inlets should be installed in all processing rooms to remove steam and moisture.

FIG. 5. GOOD TYPE OF SANITARY CREAMERY PLANT

Most cooperative and other creameries are located in small towns in good dairy districts. Often they are the newest, most substantial and most attractive business buildings in the towns. It is easy to maintain good sanitation in a building such as that shown above. Employees are proud of the institution, labor turnover is reduced and a better product is produced than in an ill-smelling, eyesore of a building that is a natural harbor for vermin

"Clean-up" Operations

In a well operated plant, "clean-up" should occupy 30 to 40% of the time spent in daily operations. This fact alone signalizes its importance in daily routine. An insanitary piece of equipment which comes in contact with the milk may undo all the care taken in the other operations. Contaminated equipment is not sterilized in the clean-up if milk stone is present. Milk stone is a mineral deposit of insoluble salts combined with casein precipitated from the milk by heat. It is always present in utensils that are improperly cleaned and is extremely difficult to avoid in areas where the water is hard. This hard deposit, thin at first, continually grows with the additional use of the equipment.

Milk stone affords an ideal place for the growth and multiplication of bacteria. Since it protects them from chemical and heat sterilization. Organic material reduces the amount of available chlorine in a bactericidal solution and thereby lessens its

effectiveness greatly. Vats and pipes, with a visible coating of milk stone, should not be used until the milk stone is removed.

All surfaces of equipment coming in contact with milk should be smooth and bright to facilitate cleaning. Most equipment in the various types of establishments is made of stainless steel, tinned copper or glass lined steel. In some instances, such as in the manufacture of swiss cheese, bare copper vats are used, but elsewhere untinned copper is objectionable because it leads to an oxidized flavor in the product and often impairs its keeping quality. This defect resulting from copper containers is less serious if the contact is only with cold milk or cream and much less apparent if the copper surface be kept bright and shining by daily scouring. However, heating to temperatures above 180°F. tends to eliminate metallic flavors, hence copper vats are less objectionable for cream that is to be churned or milk that is to be condensed since for these products, the cream or milk is heated to a high temperature.

Cleaning operations should be a part of the daily plant routine. They should be thorough and exacting and as stated previously require about one-third of the working day. Clean-up operations should include:

1. All vats used in the day's run should be rinsed with cold water and then washed with a hot alkali solution.

2. All pipes should be dismantled, rinsed in cold water and washed with a hot solution of washing powder and a power driven brush.

3. All floors should be scrubbed daily with a soap solution and a heavy brush. The ceilings and walls should receive the same treatment as often as necessary to keep them clean. Overflow of milk on the floor is not only unsightly but promotes carelessness, collects filth and furnishes food for vermin. The growth of bacteria and molds in it gives rise to disagreeable odors.

4. Débris should be kept in covered containers until disposed of properly.

5. Windows should be clean at all times and properly screened during the fly season.

6. Drain traps should be cleaned daily to insure drainage and to avoid foul odors.

The inspector should time his visits in order to see all stages of operation. The best time to determine the efficacy of "clean-up" is while it is in progress in the afternoon or in the morning before the milk or cream begins to arrive. It is then that improper cleaning methods can be detected with the least disturbance of the plant routine and pointed out to the management most effectively.

The proper use of chlorine in bactericidal treatment of dairy plant equipment is important. The inspector is interested in determining whether or not a chlorine treatment is employed and if the solution is of suitable strength; usually 50 to 100 parts per million. The solution should be tested after it has been used to determine if available chlorine is still present. The inspector should see to it that some means of sterilization, either chemical or physical is used. Live steam sterilizes very well in a confined area, but it should be remembered that it is not the steam that destroys the bacteria but the temperature to which the water vapor heats the equipment that determines the bacterial effect. Also water, at temperatures above 190°F., is an effective sterilizing agent for dairy plant equipment.

Various utensils such as cans, buckets, dippers and stirring rods, should be kept on racks when not in use. This facilitates drying after rinsing, which is one of the most important factors in the bacterial control. If a dirty piece of equipment is washed, rinsed and then thoroughly dried, the multiplication of organisms stops. Clean, dry equipment will not support bacterial growth. Any equipment, which is not sterile and is put away moist, becomes heavily contaminated in the course of a few hours.

Neatness goes a long way toward preventing carelessness, and carelessness is a prime factor in rendering an establishment insanitary. The inspector should always evaluate the general "atmosphere" of an establishment he is inspecting—the "type" of employees. He may know what to expect of any facility in the plant, but the "human element" is less predictable.

The Fluid Milk Plant

Of all milk processing plants the fluid milk plant requires the most rigid maintenance of sanitary conditions. No other dairy product is under such strict supervision by health departments. The reasons for this lie in the nature of the product. Fluid milk is more susceptible to bacterial contamination and growth than butter, cheese or ice cream and is consumed by those most vulnerable to milk borne organisms. The control of bacteria is the most important single factor in the processing of fluid milk. Without such control it is not safe. In the processing of fluid milk, the main effort is centered in the exclusion of bacteria; whereas, in the cheese industry the principal effort is to select desirable types of bacteria and to make conditions favorable for their growth. All methods of processing fluid milk are devised with bacterial control constantly in mind. The regulation of temperature is for its effect on bacteria.

Nomenclature and terms used in the milk plant are important to the inspector. He must be able to talk in terms commonly used by the milk men, and "gadget" will not suffice for more than say, a dozen appliances. A receiving room is the place where the raw product is received. Likewise the pasteurizing room is where this step of the process is carried on and as with the laboratory, bottle washing and cold storage rooms; these operations are self explanatory. So are many of the various types of equipment. Pasteurizers are used for pasteurization, surface cooler for cooling, bottle fillers for bottling, vats for holding milk, preheating or cooling it or for a combination of these processes. It may seem unnecessary to name pieces of equipment, but it is important to point out that by knowing equipment and its use, an inspector can determine not only the process but how the plant is operated. When the operation is understood, the points of contamination are more easily determined. An example of this is the use of short-time, high-temperature pasteurization.

If an inspector walks into a room and sees a S.T.H.T. pasteurizer in operation, certain questions arise in his mind, the answers to which he will want to ascertain for himself. Is it equipped with an accurate flow diversion valve? Are the heating surfaces clean and free from deposit? Is it cleaned by circulation of milk stone remover and disassembled daily? Is the length of the daily pasteurizing period such as to build up a large thermophile potential? Thus, the need for familiarity with the industry, its equipment and processes is illustrated. If the possibilities and limitations are known, then it is easier to determine what the results of any given condition will be. The inspector must, of course, be familiar with textbooks and periodical literature on the manufacture of dairy products, but this is not enough. First hand knowledge is needed.

Receiving Operations

Receiving room operations may differ in detail but all follow a definite procedure. Operations consist of:

1. Grading the raw product: Smell, taste, temperature, taking samples for (Babcock, meythelene blue reduction and acidity and direct count) laboratory tests.
2. Dumping the product.
3. Recording the weights.
4. Washing and returning the cans to the carrier.

The receiving room ordinarily will contain in addition to the can washer and weigh tank, a receiving tank, pump, and often a filter. All require examination for cleanliness.

The receiving room should conform to all the specifications applying to dairy plants. It should be clean, light and have ample room for operations. It should contain (in the case of a milk plant) a suitable weigh and receiving tank assembly and a can washer of some type. The cans of milk should enter it on a conveyor through a small opening fitted with self-closing doors and leave it, after they are emptied and washed, in the same manner. It is best to have no door permitting ingress of persons from outside the building.

If inspection is made before operations for the day begin, it should include determining if all equipment is clean, smooth and free from collected milk stone or other collected dirt. If the weigh tank is tinned copper, the seams should be tinned and have no loose solder or rough edges. If receiving room is in operation, the efficacy of the can washing operation should be checked and a number of cans inspected to determine if they are clean, hot and dry and whether or not they contain milk stone or other milk residue. Clean, dry cans, that are still hot, mean efficiency of the can washer. The can washer also should be inspected by checking the spray jets and pressure gauges and the strength of the alkali rinse. The best place to check the

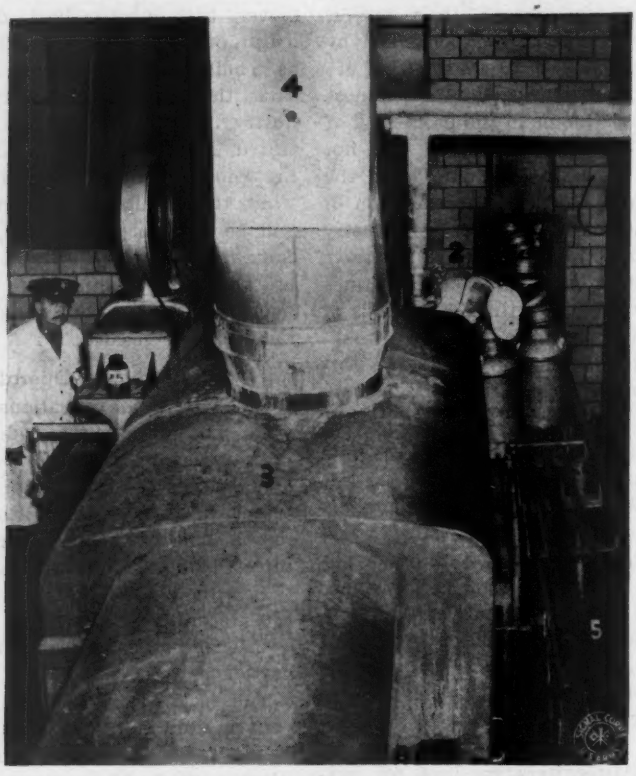


FIG. 6. CORNER OF A RECEIVING ROOM IN A FLUID MILK PLANT

The cans of milk are brought to the plant on a truck. They are placed on a conveyor outside the building and carried into the plant through the small opening (1) which is equipped with self-closing, double doors (shown open) which are pushed open by the cans as they are carried through. They close automatically when the can is out of the way. In some plants two pieces of burlap overlapping each other six to eight inches in the middle of the opening, replace the doors. Such curtains are even more effective than swinging doors in excluding flies. The cans are lifted from the conveyor and emptied by the operator (2) after he has examined the milk (shown smelling it) and found it satisfactory. If unsatisfactory, the can of milk is left on the conveyor and returned to the truck through a side door at the other end of the room. After the milk is emptied the can is started on its way through the straight-away can washer (3). It enters the washer at the far end and leaves it at the opposite end (not shown). While passing through the washer the can is rinsed in cold water, sprayed with an alkaline solution, rinsed again, heated with live steam and finally dried by a blast of hot air. The can lids, which undergo similar treatment, are then placed on the can, the can put on the conveyor and returned to the truck on the outside of the building. All this is accomplished automatically by the mechanical can washer and the conveyor. (4) Hot air intake for drying cans. (5) Can conveyor. (6) Weigh tank assembly. Some weighers are equipped with a weigh-o-graph which speeds up the operation. The inspector should examine the milk as it enters the receiving room for sediment and off-odors and, as they leave the washer, the cans should be examined for cleanliness, milk stone deposit, rust spots, rough places, open seams and the absence of moisture

efficiency of can washing is on the inside of the shoulder of the cans. Well ordered efficiency has a lot to do with the milk plant in general and exerts considerable weight on the formulation of an opinion as to the degree of sanitation maintained in its operation.

An intermediate step between receiving and pasteurizing is the holding of raw milk. This is not necessary to all plants but it is the coordinating factor that allows for the different speeds with which operations are carried out. Milk may be received more rapidly than it can be pasteurized or in the case of the city plant operating in conjunction with the country receiving station, it is necessary to have a bulk storage to accommodate the day's supply. In any instance, where raw milk storage in bulk is necessary, adequate accommodations should be provided. Holding tanks should maintain a temperature not higher than 50°F. with not more than two degrees variation over a period of 24 hours. Lower temperatures are desirable, 40 being far preferable to 50°F.

Filtering—Clarification

Before milk is pasteurized, it is subjected to some sort of mechanical "clean up" treatment. This can be done by filtering or clarification. The inspector should determine which of these processes is in use. If the latter is employed, or if the milk is to

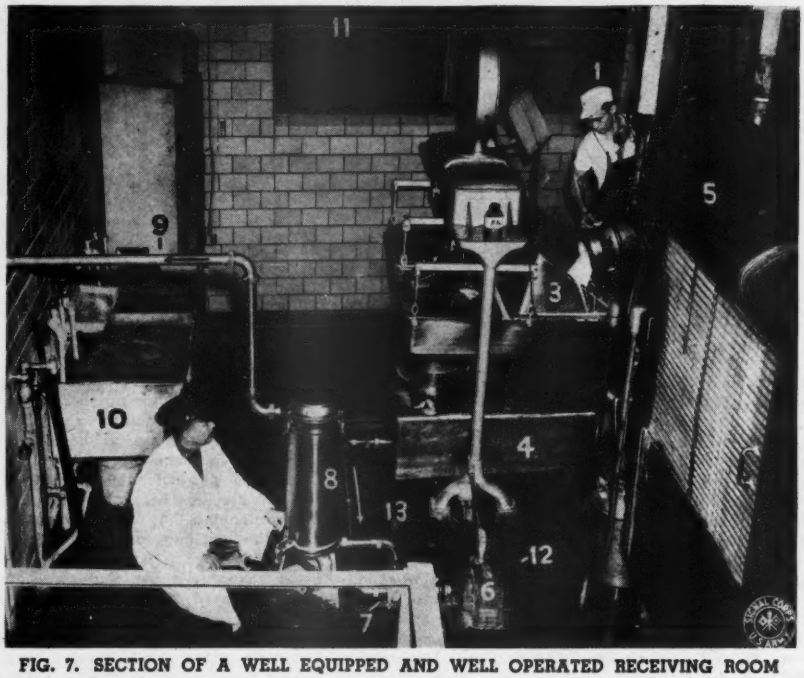


FIG. 7. SECTION OF A WELL EQUIPPED AND WELL OPERATED RECEIVING ROOM

(1) Emptying milk into the weigh or dump tank. (2) Scales. (3) Weigh tank. (4) Receiving tank. Although it is common practice to leave the lids off both these tanks while operating, thus exposing the milk to flies, some of which inevitably gain entrance to the room with the milk cans, good practice requires that these and other milk receptacles be kept covered all the time. (5) Can washer (shown at (3) in Fig. 6). (6) Motor for pump. (7) Rotary pump which forces the milk through the filter (8) and through sanitary pipe (9) into the storage tank in the next room (direction milk is forced is indicated by arrows). (10) Tank for washing receiving room equipment. (11) Ample windows for lighting (all screened). (12) Well placed floor drain. (13) Tile floor. Tile floors are much preferred to ordinary concrete for milk plants. Cement deteriorates rapidly from milk, washing solutions and frequent change of temperature and is soon cracked, chipped and uneven, resulting in pools which may be splashed on equipment and products. Of the equipment in this room, the can washer is the more likely to be improperly operated. Jets may become plugged, the soaking solution may contain insufficient alkali, the steam jets may not heat the cans sufficiently and the hot air blast may not dry them thoroughly. The pump and the filter are two "critical" points for the inspector

be separated it is usually preheated to raise it to a proper temperature for clarification, usually 85 to 90°F. Most preheaters consist of a series of jacketed tubes, constituting a large heating area, through which the milk is circulated as heat is applied in the jacket. The milk is subjected to a high temperature in the tubes and this often causes a film of milk to be "baked on" the inner surfaces, making them difficult to clean. Deposit accumulates easily on these surfaces which provide excellent conditions for the formation of milk stone. Preheaters should be cleaned with both wire and soft brushes for best results. A good operator can get maximum efficiency without using a temperature so high that milk is baked on the surfaces, if the heating area is sufficiently large to accommodate the quantity of milk passing through. Excessive daily deposits indicate a need for better operation.

FIG. 8. CORNER IN A PASTEURIZING ROOM

(1) Storage tank. This tank is insulated and will hold milk for 24 hours with a variation of only two or three degrees in temperature. Milk is stored here until pasteurized. It is a better practice to run it over a cooler before storing it or to have a cooling coil in the tank. Otherwise, as in this case, when milk is received faster than it can be pasteurized, it may often be held for several hours at the temperature as received from the farms—often 60° F. or even higher, which results in bacterial growth and lowered quality. (2) Rack for sanitary pipe. (3) Soak tank for sanitary pipe. (4) Motor which rotates sanitary pipe cleaner. (5) Brass ferrule enclosing shaft of rotary brush cleaner. (6) Rotary brush, composed of stiff bristles and soft copper wire. This brush is very efficient in cleaning the interior of sanitary piping and preventing the accumulation of milk stone deposit. Some of the washing solution from the tank (3) is forced out through the brush as it rotates. The shaft on which the brush is mounted must be at least half as long as the longest section of pipe to be washed. Almost never does one find clean pipes, free from accumulations of milk stone, in a plant where hand brushes are used for washing them. A rotary brush washer of the type illustrated reduces, greatly, the amount of hand labor involved and also the time required to properly clean sanitary piping. Long sections of this pipe are objectionable because they are more difficult to wash than short sections. The interior of sanitary pipes should receive careful attention from the inspector. Nothing short of a mirror-like, unscratched interior surface is satisfactory

The separator and clarifier are identical except for the type of discs used. Clarifier discs are not perforated to allow fat separation as are those in the separator. They both operate on the same principal—the bowl whirls at high speed, creating tre-

mendous centrifugal force to which the milk is subjected. All foreign material heavier than milk is deposited, as slime, on the inner surface of the bowl. Clarification removes also leucocytes, erythrocytes and, because of the cohesive nature of the slime, a small number of bacteria are incorporated in it as the material is thrown outward to the side of the bowl. However, reduction of the bacteria content of milk is not the purpose of clarification.

To prevent foaming some modern separators and clarifiers in common use are of a so-called no-foam type; i.e., they are sealed against the atmosphere. Both inlet and outlet connections should be fitted with sanitary pipes. Open troughs leading from the clarifier and separator to vats or cans should be eliminated. The separator and clarifier present no particular sanitary problem if they are dismantled and cleaned thoroughly every day. Rubber gaskets on the no-foam types should be soaked in a mild chlorine solution overnight. The inspector should see the machine while it is dismantled and after it has been cleaned. He should inspect each part, paying particular attention to the condition of the discs and to the base of the core (spindle). The inside of the bowl should be clean and bright, and the gasket molding should be free from collected residue. The bowl and locknut should be removed for inspection and the condition of the inlet pipes should be ascertained.

The efficiency of the clarifier in improving the physical condition of milk cannot be questioned. In considering its use it is well to remember that it removes not only the visible dirt, but much of the invisible dirt as well.

The filter method is not quite as efficient as is the use of the clarifier but is more commonly used. There are many types of filters. All embody the same basic principles; that is, filtering the milk through a sterile cloth or fiber pad. Filters are efficacious in removing visible foreign material but it is doubtful if the best of them reach the degree of perfection attained by the clarifier. If a filter is in use, the inspector must be reasonably certain that the cloths or pads are not re-used after one operation. Cloth filters are generally used after the milk is preheated, while the newer, "frigid flow" types filter the milk direct from the receiving tank or storage tank. From a sanitary viewpoint they present little difficulty, if the cloths or pads are not reused and the filter itself is dismantled and properly cleaned. Filtering the cold milk as it leaves receiving tank is preferable to filtering it later, after it has passed through one or more pumps, a preheater, or perhaps a storage tank, since these processes break the foreign material up into finer and finer particles and more of it dissolves so that it passes through the filter. Filtering after pasteurization is highly objectionable.

Pasteurization

This process is a heat treatment of milk to destroy pathogenic bacteria. It also reduces in number other bacteria the growth of which injures the flavor of milk or causes other undesirable changes. In the manufacture of various dairy products other than fluid milk, pasteurization plays an important part in inhibiting or promoting bacterial growth. Its primary purpose in fluid milk is the destruction of pathogenic bacteria. It also delays souring by destroying nearly all of the lactic acid producing bacteria. Two principal methods of pasteurization now in general use are: (1) the holding method — the oldest and most generally used. By this method the milk is heated in pasteurizing vats to a temperature of 143 to 145°F. and held at that temperature for 30 minutes; then cooled immediately and bottled. (2) The high-temperature, short-time method. In large plants it is practical to use this latter method, combined with the regenerative principle. By this method, the milk is heated rapidly to 161 to 162°F., and held at the temperature for 15 to 16 seconds. High-temperature, short-time pasteurization has many advantages. Its efficiency depends on a flow diversion valve that allows only properly heated milk to flow to the filling unit.

Pasteurizers should be clean; free from accumulated deposits and sterilized with a chlorine solution before use. Vat pasteur-

izers should have an approved flush type of outlet valve and foam heaters to regulate the air temperature above the milk to 5°F. higher than the pasteurizing temperature. They should be equipped with indicating and recording thermometers. The accuracy of the latter should be checked with the former regularly. Recording disc charts should be dated and kept as a permanent record of each day's operation. The inspector should check these charts at each inspection. A phosphatase field kit may be used to advantage to determine that pasteurization has been complete. To convey the milk to and from the pasteurizer several pumps are necessary. In the case of the holding method, they are generally rotary pumps—either disc or blade type. These pumps should be checked for cleanliness and to ascertain that the packing washers are well seated. There is often a deposit of slime on the outside of the pump. This should be removed daily and the pump should be kept clean outside as well as inside.

In the high-temperature, short-time method of pasteurization, there is a "positive" pump that regulates the flow of milk in an airtight circuit. The speed of the flowing milk is regulated to 16 seconds from the time it leaves the heater until it reaches the flow diversion valve. Inspection of a short-time, high-temperature pasteurizer is difficult because, when it is assembled, all the working parts are concealed. If it is the habit of the operator to assemble the parts just prior to operation, they may be inspected for cleanliness at that time and checked for operation after the run begins. There are generally many

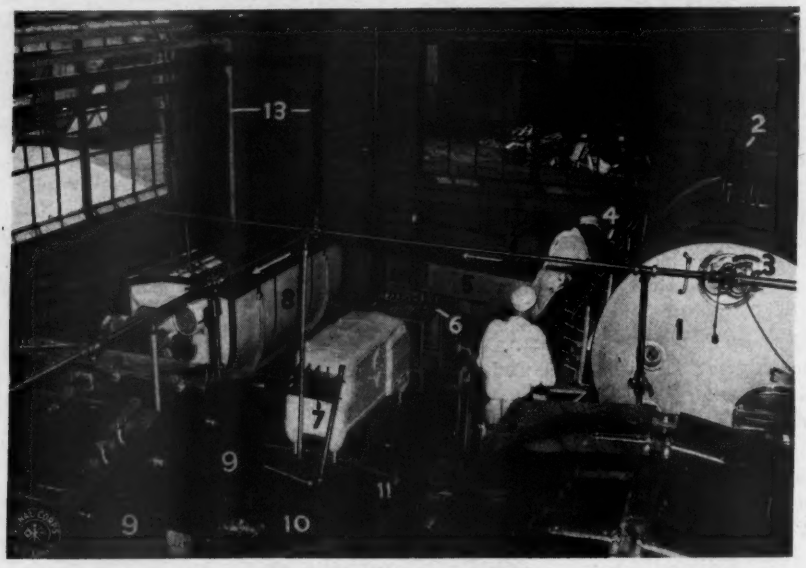


FIG. 9. PASTEURIZING ROOM

(1) Storage tank (same as shown in 1, Fig. 8). (2) Motor to operate the agitator in the tank. (3) Two-way valve by which milk from the filter (8, Fig. 7) may be channelled into the storage tank, to the preheater or to the pasteurizers. (4) Rotary washer for sanitary pipe (shown at 3, 4, 5 and 6 in Fig. 8). (5) Tank in which homogenizer parts and other equipment are washed. The shelves (left end) are a convenience. (6) Homogenizer parts dissembled (on movable table). (7) Sanitary homogenizer head (all movable parts removed). (8) Coil vat used as preheater for milk to be homogenized or pasteurized. (9) Stainless steel vat pasteurizers. (10) Tile floor. (11) Floor drain. (12) Stainless steel by-products vat with vertical coil. (13) Insulated pipes which carry steam to the preheater and pasteurizers. The arrows indicate the direction of milk flow in the sanitary pipes. A pump, at the proximal end of the storage tank which drives the milk from the tank to the various vats is hidden from sight by the by-products tank (12). Note the recessed valve in the pasteurizer (9) through which the vat is emptied and the milk conveyed to the cooler. Note also the collars on the openings through the pasteurizer covers, which prevent liquids on the covers from draining into the pasteurizer

sanitary pipes used in a high-temperature, short-time "hook-up." They are part of the pasteurizer and some are subject to the same temperatures as the heating plates. All such parts must be cleaned as completely and as thoroughly as the plate heating surfaces. The temperature for S.T.H.T. pasteurization, 162°F. is relatively high and wherever high temperatures are used anywhere in the processing of milk, cleaning the equipment is made more difficult since a thin film of milk is likely to be baked on the hot metal surfaces at these temperatures and careless operators often do a poor job of removing it.

As the efficiency of a S.T.H.T. unit depends on the flow diversion valve, it must be accurate and operate properly. It should be dismantled and cleaned thoroughly not only to keep it sanitary but to prevent it from "sticking" as well. Indicating and recording thermometers placed at different stages of the operation should be checked the same as for vat pasteurization. Rubber gaskets that seal the chambers in a plate heater should fit tight, be clean and in good condition. During operation the pressure on the pasteurized milk side of the plates should be greater than on the raw milk side.

Cooling is the intermittent step between pasteurizing and bottling. In the high-temperature operation this is done by a cooling unit built into the equipment but in the case of vat pasteurization the milk is usually passed over a surface cooler. As with all other dairy equipment, the cooler

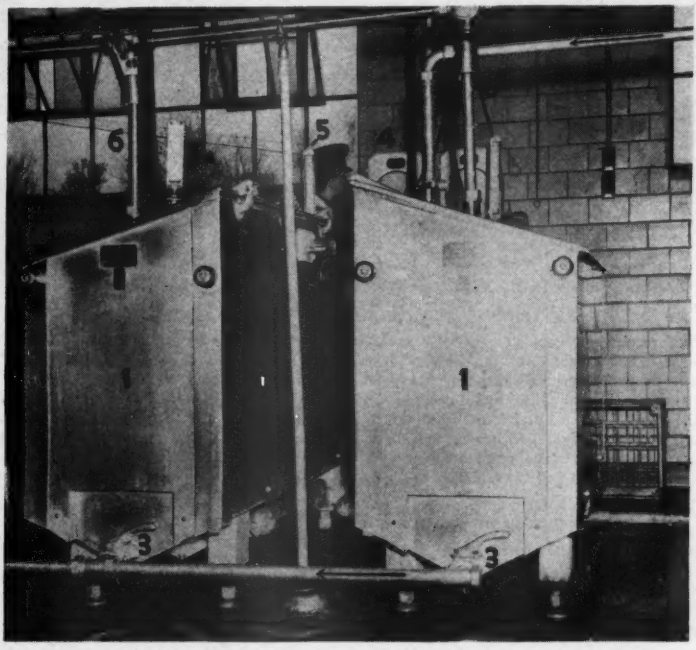


FIG. 10. CLOSE-UP VIEW OF STAINLESS STEEL SPRAY PASTEURIZERS

(1) Pasteurizer vats (shown also at 9 in Fig. 9). (2) Sanitary pipes that convey milk into the pasteurizers (better view in Fig. 9). (3) Outlet valves. These are set flush with the interior of the vat so that there is no milk in the outlet pipe which is not heated to as high a temperature as that in the body of the tank. (4) Recording thermometer (being examined by the inspector) of pasteurizer at the left. The disc records are saved for later inspection. (5) Indicating thermometer. This thermometer extends deep into the milk. The recording thermometer (4) must be compared with it at least once during the pasteurizing of each batch of milk. (5a) Air and foam thermometer. (6) Inlet pipes, disconnected while the pasteurizer is in operation. Note the tiled walls which are easily cleaned and the large area of screened windows affording ample light. The preheater vat, the pasteurizers, the pipes and the valves conveying milk from them, being in the "hot lines," are more difficult to clean than equipment that contacts only unheated milk, hence require more careful inspection. The arrow indicates the direction of the milk when it leaves the pasteurizers and is on the way to the cooler and thence to the bottling machine

should be clean and smooth. Surface coolers should be protected from dust, flies and moisture of condensation by a metal cover. The cooler should be easy to clean and easily accessible to the operator. Leaks in the cooler are often a source of contamination of the pasteurized milk. The cooler should be one of the first places checked when coliform organisms are found in pasteurized milk. The inspector should make sure there are no rough surfaces on cooler, or cracks between the coils, and that moisture condensed on the frame cannot drain into the milk, i.e. drip diversion should be provided. Coliform organisms in pasteurized milk usually indicate contamination after pasteurization. Surface coolers are often the source of such contamination, however, any of the equipment with which the milk comes in contact after pasteurization may, of course, be responsible for coliform contamination.

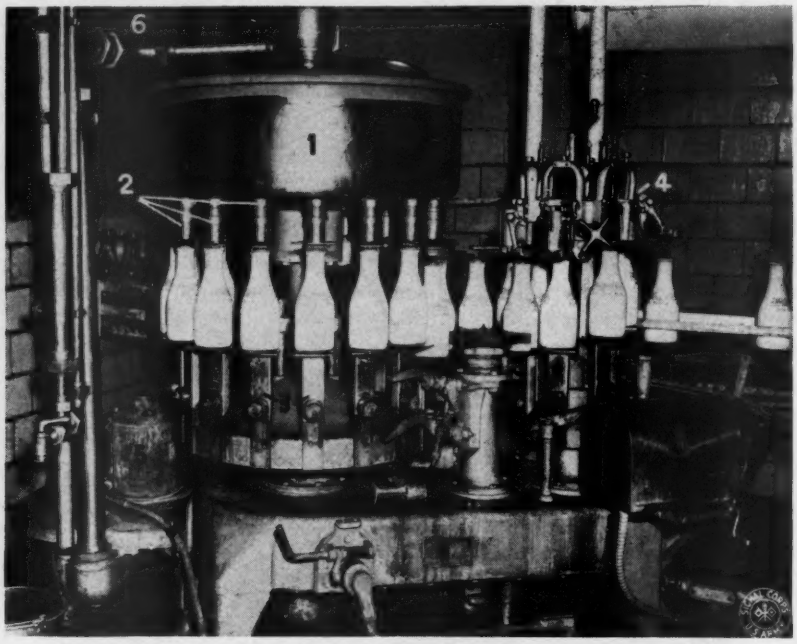


FIG. 11. MILWAUKEE BOTTLE FILLER IN OPERATION

(1) Filler bowl containing cooled, pasteurized milk. Float operated valves regulate the flow of milk from the cooler or a storage tank into the bowl. (2) Nozzles fitted with rubber gaskets for filling bottles as they are raised on the elevators. (3) Elevators. (4) Rotary bottle capper showing capper heads and, above, the sanitary tubes containing the plugs which are placed in the bottles automatically. (5) Vacuum pump (gra-vac attachment) that exhausts air from the filler bowl and indirectly from the bottles into which the milk is drawn. (6) Vacuum line from filler bowl to vacuum pump. The filled bottles at the right are being conveyed to the hooding machine. The empty bottles at the extreme left and behind the bottle filler are on a conveyor (3 in Fig. 13) from the bottle washer in an adjoining room

Homogenization

Milk should be homogenized at or near the pasteurization temperature. There is a difference of opinion as to whether this operation should immediately follow pasteurization. In the past, homogenizers were not of sanitary construction and it was necessary that this operation should precede pasteurization. This requires somewhat more careful attention in the vat or holding method. Homogenization breaks up the fat globules, thus increasing the surface area of the fat in the milk and enables the lipase enzyme, which is always present in raw milk, to react quickly with the fat and develop rancidity almost at once. Pasteurization temperature renders lipase inactive, so that homogenization has no effect on the

development of rancidity if this step follows pasteurization.

If the milk is heated to pasteurizing temperature within a few seconds after homogenization, as occurs in S.T.H.T. pasteurization, the lipase activity is suppressed. Homogenization may be accomplished just after the raw milk has been warmed in the regenerator and before it passes into the final heating stage. In this way it will be at a proper homogenizing temperature and pass into final heating stages before the lipase can act.

In the holding method of pasteurization, it is sometimes simpler to homogenize after pasteurization but this is not permitted by some health departments. . Without the use of a preheater it is difficult to heat the milk rapidly enough to halt lipase action where homogenization takes place before pasteurization. With the sanitary homogenizers now available, there is little excuse for homogenization before pasteurization.

The sanitary inspection of the homogenizer should be thorough. The machine handles milk at relatively high temperatures and is prone to collect deposits. Its sanitation depends upon the condition of the packing about the pistons, which keeps the milk from working out around the cylinder wall. This packing should be replaced often, to maintain it in a sanitary operating condition, and should be removed and kept in a chlorine solution between runs. The whole machine, that is to say, the whole operating

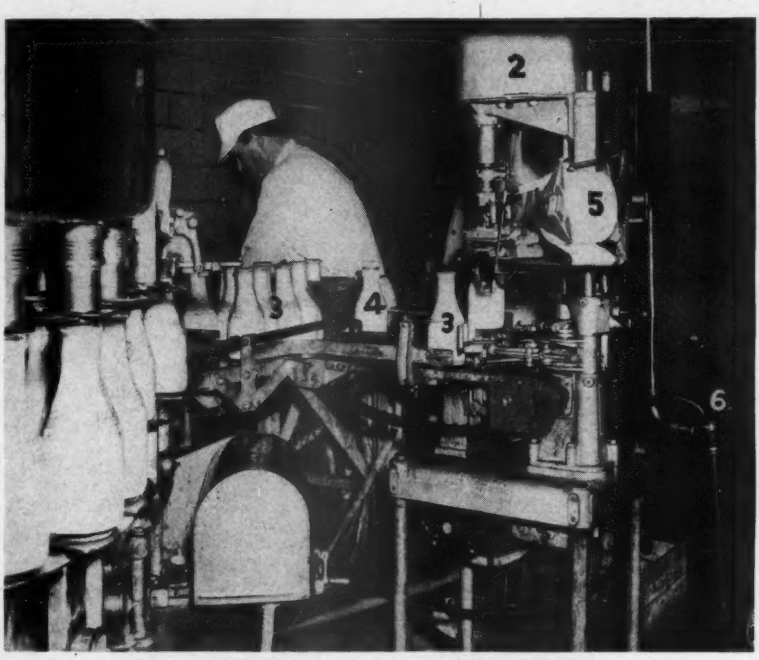


FIG. 12. BOTTLE FILLER AND HOODING ASSEMBLY

(1) Filler bowl (also 1 in Fig. 11). (2) Hooding machine, which tapeseals a parchment or cellophane hood cap. (3) Bottles (with plug caps in) on conveyor from the bottle capper (shown at 4 in Fig. 11), to the hooding machine. (4) Hooded bottle ready for the storage room. (5) Roll of sanitary parchment from which the hoods are clipped. (6) Can filler for filling cans to be sold as bulk milk; not a part of the hooding machine. The hood is an excellent sanitary device since it protects the bottle cap (plug) and pouring lip from dirty hands, dust, flies and other sources of contamination. It should be recognized that contamination on the bottle cap, regardless of how neatly the cap fits, has access to the milk beneath it. The changes in temperature to which most bottled milk is subjected during delivery and use results in some of the bottle contents being forced past the cap and later, it and condensation, is drawn into the bottle by cooling of the milk when it is placed in a refrigerator. Since bottles are usually picked up by the top, the pouring lip is subject to frequent contamination in handling and requires the protection of a hood for sanitary reasons. Bottle caps that cover only a portion of the lip do not meet army requirements

head should be dismantled and thoroughly cleaned. After every operation, pistons and packing as well as all other moving parts should be removed, and like all other equipment, the homogenizer block should be sterilized with chlorine just before the "run." Operating the homogenizer on water alone is thought by some to be injurious to the pistons and they object to the chlorine rinse on these grounds. However, such is not the case. The manufacturers of such equipment advise the pumping of ample chlorine solution through the machine before it is used.

Bottling

There is little use in stressing the sanitary production and processing of high quality milk if it is to be placed in dirty containers. Bottles, bottle washing and bottling must receive the same meticulous attention from the inspector that is given to all other steps in the handling of fluid milk. Washing and filling bottles should be a continuous operation. Bottles should proceed directly from the washer to the bottle filling machine. It is good practice to take samples from the washed bottles for bacteriologic examination in the laboratory to determine the efficacy of the washing. Samples of the washing solutions may be sent to the laboratory to determine the sodium hydroxide content. The chlorine rinse should be tested to determine its strength or that it still contains available chlorine after it has been used. Washers are operated at different temperatures and vary with the strength of the alkali used. The inspector should familiarize himself with the requirements of the particular machine he is inspecting. Soaking temperatures should be from 140 to 160°F. and the strength of the solution should be between 1 and 2% caustic soda (sufficient to give a pH of 12 to 13).

In very small milk plants the milk bottles may be washed by hand; in larger plants

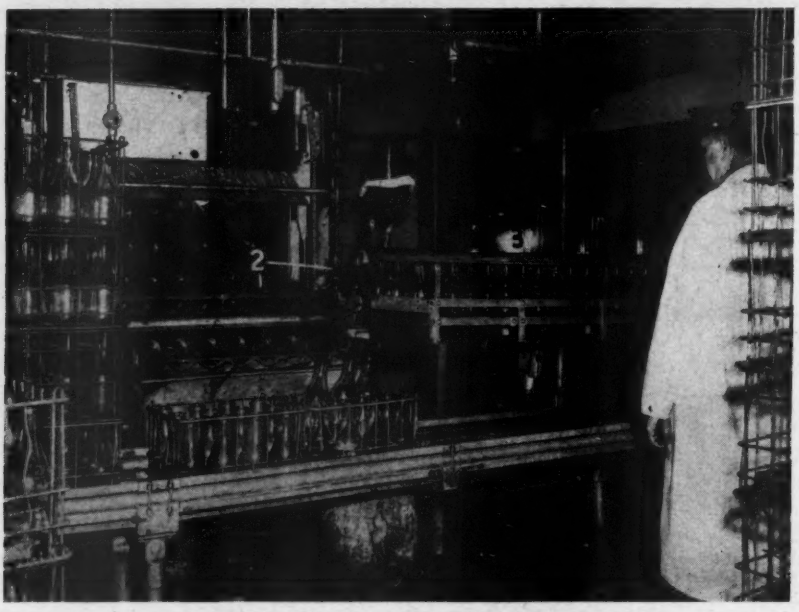


FIG. 13. MECHANICAL MILK BOTTLE WASHER

(1) Dirty bottles entering the washer. (2) Clean bottles emerging from the washer. (3) Conveyor which transports clean bottles to the bottle filler (Fig. 11). Note that the conveyor is covered to protect the bottles from condensation dripping from the ceiling and overhead pipes. Bottles enter the washer at (1) are first rinsed by high pressure jets of cold water, then soaked in a washing solution, rinsed again and then chlorinated before ejection at (2). They are then placed on the conveyor (3) for transport to the bottling room. When the bottles come out of the bottle washer, they should be inspected under a strong light to ascertain that there is no coagulated milk, chocolate or other extraneous matter left in the bottle. Bottles not visibly clean should be brushed by hand and sent through the washer again

various types of mechanical washers are employed. Bottle washers are rather complex machines, combining several phases of the cleaning operation into one continuous process. The bottles are fed into the machine by hand and the following steps are accomplished mechanically: First, they are rinsed with the jet of clear water under high pressure in order to remove residue from former contents. Then, they are placed into receptacles on a moving conveyor which carries them through the remainder of the process in the following order: The soaking tanks containing caustic solutions, the warm and cool rinsing tanks and, finally, the chlorine solution tanks. Washers vary greatly in construction. Rinsing and chlorinating may be done by sprays instead of bottle immersion. Some washers are equipped with brushes in addition to the hydraulic and soaking processes. The many variations in washer design is the reason why the inspector should familiarize himself with the type of machine with which he is dealing. A clean bottle, meeting standard requirements of not over 1000 bacteria per 1000cc of volume is proof that the machine is in efficient operation. However, good washers render a large percentage of the bottles sterile and thus provide a desir-

FIG. 14. EMPTY BOTTLES AWAITING WASHING

The accumulation of dirty milk bottles any afternoon in the average fluid milk plant is astonishing. Washing them is a greater task than is pasteurizing the milk. The glass milk bottle is expensive, adds greatly to the tonnage in milk delivery and, to a degree, is insanitary and soon broken yet it has held the field as the container of choice for retail milk distribution over a long period. Its greatest disadvantage from a sanitary viewpoint is the bringing of contamination from hundreds, even thousands, of homes to a central distributing point for milk, with the possibility always existing of infecting employees at the plant, or in case of some mishap, the product. A suitable container, to be used once and discarded, has long been sought and various types of such containers are on the market. Certain disadvantages, including cost, consumers' preference, inertia of municipal health commissions, opposition of those interested in the supply of bottles, bottle washers, washing powders or bottle cases, and the necessity for re-equipping existing milk plants to handle a different type of container have prevented general adoption of single service containers. One heavy expense in the use of glass bottles is loss and breakage. This can be reduced, in army posts, practically to the vanishing point by a little effort on the part of the milk inspection service. This saving is reflected in the cost of the milk to such posts. Attention should be given also to preventing the deposit of cigarette butts, garbage and other filth in empty milk bottles

able margin of safety over minimum requirements.

The final step of the fluid milk preparation, putting the milk into bottles, is no less important than the others. A poor procedure or a poor operation here may defeat all the care that has been taken in all the other steps from the dairy barn to the milk cooler. Bottles should be conveyed from the washer to the filler on a belt conveyor, covered with a hood so as to protect them from air current contamination or from ceiling drip if it be present. Bottles must not be handled until they are filled and capped. The conveyor and the elevators on the filler should be clean and free from a scum deposit caused by overflow milk. Bottles often break at the filler allowing the lost milk to spill down over the body of the filler into the gears and around the legs. Repetition of this causes scum deposits that give rise to enormous bacterial growth and foul odors. All equipment should be clean inside and outside. Some provision should be made for milk discarded from dirty or cracked bottles. In commercial practice it is commonly diverted to the manufacture of some other dairy product.

The floor around the filler should be kept clean during operation, free from broken glass, waste caps and hoods. Waste containers with covers should be provided, convenient to the operator. The filler should be rinsed, after bottling for the day is finished, and thoroughly cleaned. Likely places for laxity in cleaning operation are the hollow stems and the valve rubbers. These valve rubbers should be washed in a mild alkali and stored in a weak chlorine solution when not in use. Many operators think rubber lasts longer without developing fine cracks if stored in a bactericidal alkali solution.

FIG. 15. STORAGE OF PASTEURIZED BOTTLED MILK

(1) Recording thermometer, keeping accurate record of all temperature fluctuations of cold storage room. Cold storage rooms should be maintained at a temperature of 40° F. or lower. A cold storage temperature of 35 is better than 40° F., as it provides a margin of safety and a lower starting temperature on the delivery route. Cold weather storage temperatures are often maintained at a higher level to keep milk from freezing after it gets on the routes. If, as is a common practice, storage temperature is raised to 50° F. in cold weather, there will be a marked increase in the bacteria count of such milk. There is practically no bacterial growth in reasonably clean milk stored at 32° F. for 24 hours, only moderate growth between 35 and 40° F. for the same period, but at 50° F. there is a marked increase in growth

Fluid Milk Storage

The cold storage rooms should be held at temperatures of 35 to 45°F. The floor should be clean, free of pools of standing water and excess moisture. Walls and ceilings should be in good repair with no dropping of insulation material where the ceiling is unplastered. Excess moisture in the cold storage room is undesirable from a sanitary standpoint. When hood caps are not used to cover the top of the bottles, condensate from the walls and ceilings saturate the exposed plug caps and increase the possibility of outside contamination. Only hood caps should be used.

Toilets and Lavatories

Toilet facilities should be easily accessible, adequate and clean. Toilet rooms should contain wash bowls supplied with hot and cold water and should not open directly into any room where milk is processed. Additional hand washing facilities should be located cenveniently throughout the plant and employees should be instructed in personal hygiene. Placards, on the doors of toilet-rooms, directing that the hands be washed before leaving the room are worth while.

Summary

The preceding discussion is general in nature. Nearly every factor connected with the inspection of a fluid milk plant requires far more description to make it complete, but such descriptions would be of a nature that the inspector can work out for himself. In every plant there are conditions peculiar to that plant, that must be evaluated on their merits. Inspection is the application of a general knowledge to a specific task. Close observation, adroit questioning of employees, experience and resourcefulness will take care of the situation. Where objection is made by the management to the adoption of good sanitary measures it is nearly always on the ground of expense. The experienced inspector knows that there are few expenditures a milk processor can make that pay as good dividends as do expenditures for good sanitation. When he has convinced the operator of this, he has gone far toward getting the willing cooperation of both manager and employees.

Sample Report of Sanitary Inspection of a Fluid Milk Plant

1. *General.*—This dairy processing plant is located in the business section of ————. Approximately one-half of its production is supplied to army installations and the remainder is distributed in a city where many officers and their families live.

2. *Building.*—The building is a three-story structure, partly new, partly old construction. The new construction houses the fluid milk and ice cream operations. The old construction houses the remainder of the processing including a by-products room, offices, retail store, and storage rooms.

a. Rooms: The rooms are of adequate size to facilitate cleaning around equipment. Separate rooms are provided for each milk operation.

b. Walls and Ceiling: The walls are of glazed tile in the new portion of the building which are easily washed and were clean. The walls in the old portion are of wood, but are painted and clean. The ceilings are of white plaster and are clean and dry.

c. Floors: The floors in the new portion are of impervious brick tile, pitched to well placed drains. In the by-products room, the floors are of cement with some areas where water may stand.

d. Toilet: The toilet is conveniently located with approved double doors so that they do not open directly into the milk room. The room is clean, but no soap or sanitary towels were provided when the inspection was made.

e. Windows and doors:

(1) The windows are sufficient in number, satisfactorily located and screened.

(2) The screen doors are in good condition and are self closing. The self-closing, double doors for receiving and returning milk cans are adequate.

3. *Equipment.*—The equipment in general is fairly new and in good condition.

a. Receiving room equipment:

(1) The weigh tank is of stainless steel; in good condition and clean.

(2) The can washer is the straight-away type. The cans came out clean, hot and dry.

(3) The milk passes through a rotary pump and filter between the receiving and pasteurizing rooms. The filter is a cloth bag type. This was in operation when the inspection was made so internal parts were not inspected.

b. Pasteurizing room equipment:

(1) The holding tank is of stainless steel; in good condition and clean.

(2) Four spray vat pasteurizers, with recording thermometers are used. These were in good condition and clean. Two were in operation and the recording thermometers were functioning properly. Pasteurizing is at 143°F. for 30 minutes. Temperature charts are preserved for inspection.

(3) The round cream vat is clean and in good condition.

(4) The coil by-products vat is in good condition, but contained a small amount of milk stone. It was not equipped with a recording theromometer.

(5) The separator apparently is in good condition and clean. The internal parts were not inspected as it was in operation.

(6) The homogenizer was in operation, but in good condition and externally clean.

(7) The sanitary pipings are of stainless steel, of approved construction four and six feet lengths. The pipes that were not in operation at time of inspection were clean and in good condition.

(8) The pipe washer is of the rotary type and apparently doing a good job.

c. Bottling room equipment:

(1) The cooler is a Cherry-Burrell, cabinet type; clean and in good condition.

(2) The bottle filler is a Milwaukee type, with Gray-Vac attachment. The rubber nozzles were clean and in good condition.

(3) The hooder was functioning properly, clean and in good condition.

d. The milk storage cooler was clean, temperature 40°F.

e. Bottle washer room equipment:

(1) This room contains the bottle washer only. It is an old Meyer-Dumore eight-bottle, combination soaker and brush type. The soaking solution was 140 to 160°F.; alkali 3%. The bottles were returned clean and dry.

f. Ice Cream room equipment:

(1) One Cherry-Burrell, 40-quart, direct expansion batch freezer is used. This is old equipment but doing an adequate job. A new continuous freezer has been ordered.

(2) There is one Vogt continuous freezer direct expansion type. It has not been in operation for some time.

g. Hardening room:

(1) This room is small but adequate and clean. The temperature was zero F.

h. By-products room:

(1) Two skim milk storage tanks; 500 gallon capacity with recording thermometer are employed.

FIG. 16. CONTROL LABORATORY FOR FLUID MILK PLANT

(1) Mojonnier tester. (2) Analytical balance. (3) Centrifuge for the Babcock test

A well equipped and well managed control laboratory is an essential part of a properly operated fluid milk plant, creamery or plant producing evaporated milk or milk powder, both for sanitary control and for efficient, economical operation. The army inspector finds the laboratory records invaluable in reflecting the operation of the plant during the periods between his visits

(2) One hot well for pre-heating milk for a vacuum pan is clean and in good condition.

(3) Two 350-gallon Pfiauder glass-lined vat pasteurizers are clean and in good condition.

(4) There is one viscolizer; clean and in good condition.

(5) One Cherry-Burrell surface cooler is used for mix manufacturing. It is old but clean.

(6) There is a pipe washer and tank. No pipes were dismantled, so the interiors were not inspected.

i. The cooler is adequate; 38°F., clean and in good condition.

4. *Personnel.*—The employees were wearing clothing appropriate for their duties, were neat and appeared to be competent and interested in their work.

5. Recommendations:

a. That this plant be approved for the supply of fluid milk for the use of military personnel.

Capt. V.C.

The Creamery

Although an establishment engaged principally in the manufacture of butter is called a creamery, the demarcation of a creamery from other milk processing plants is not always easy or definite. Butter manufacturing may be a side line operation in any dairy plant and most creameries manufacture one or more other dairy products, such as sweet cream, dried buttermilk or ice cream mix, as side line, or even as a major line, in their business. The sanitary requirements for a given plant are those of the most vulnerable product processed therein.

Although butter as a finished product is not as susceptible to contamination by pathogenic organisms as fluid milk, and does not provide such ideal conditions for the growth and multiplication of bacteria, it is well to enforce the same sanitary requirements as for fluid milk plants, particularly if, as is often the case, the establishment supplies fluid milk at wholesale to city distributors, either regularly or on special occasions.

Building requirements as to construction and sanitation should be just as rigid. Maintenance of sanitary regulations and sanitary practices should be enforced. It requires skill to manufacture dairy products and in most instances pride is taken in

FIG. 17. CHURN ROOM IN A SMALL CREAMERY

(1) A 2,000-lb. vane churn. (2) Roller type churn. (3) 64-lb. butter tubs filled with fresh butter. Note that the tubs are covered with parchment paper as soon as filled. They are lined with parchment paper also. If stacked in the cold room, wooden covers should be used. Churn openings must be fitted with removable fly screens. The floor shown in the illustration is relatively new and better than the average found in milk rooms. Yet it will be noted deterioration has already set in. From a sanitary viewpoint ordinary concrete floors are not suitable for milk-room floors

turning out a quality product but creameries are not, as a rule, subjected to strict public health regulations and are not always operated in a sanitary manner. To a much greater extent than operators of fluid milk plants, creamery operators must be advised as to the advantages of good sanitary methods. The operator of a fluid milk plant experiences frequent loss from spoilage of his product and is keenly interested in means of preventing such losses. The creamery operator seldom experiences such losses and is apt to be convinced that his methods are good. This is just another way of saying that if a desired change can be bolstered by an economic reason it is easier to get it than it would be otherwise.

Different equipment and different procedures change sanitary requirements somewhat. Those requirements that apply to the creamery alone are:

Receiving Room.—All requirements of the fluid milk plant apply to the creamery as far as sanitary construction is concerned. In addition to the can washer, there is usually some means of "steam rinsing" the cans, in order to reduce the fat loss, before they are subjected to the usual washing procedures. Cream cans should be inspected with particular care as they are more difficult to clean than milk cans. In all instances, the seams on all cans should be tight and smooth. There should be no rough surfaces anywhere and of course no coating of milk stone. The inspector should determine whether or not the cream is graded as to quality (off flavors and high acidity) before it is accepted. The operator who hesitates to reject poor quality cream for fear of offending a patron, negatives all the after care that can be expended in the manufacture of butter and dooms his plant to

FIG. 18. ROTARY CAN WASHER IN A SMALL CREAMERY

(1) A five compartment rotary can washer. (2) Clean can emerging from the washer. (3) Unwashed can entering the washer. Cans entering the second compartment are given a cold water rinse; in the third compartment an alkali spray; in the fourth a sterilizing steam and hot air blast, and in the fifth compartment a drying blast of hot air. Rotary can washers have less capacity than the straight-away type) Figs. 6 and 7). They vary from two to five compartments and are capable of washing from two to six cans per minute. Rotary washers are used only in the smaller plants. The desideratum, as in the case of the larger straight-away washers, is a clean, dry can as the finished product. On inspection, the working of the jets and the strength of the alkali solution should be checked

the production of a low quality product.

Since cream is generally pasteurized at 160°F. for 30 minutes or at 185 to 195°F. or even higher, in a "flash" pasteurizer as soon as it is received, low temperature storage, until it is ready for churning, may or may not be employed.

Here again there are different types of pasteurization; either by vat method or "flash" method or a combination of the two. Regeneration is sometimes applied to cream pasteurization, but it is not in general use. There are two types of "flash" pasteurizers in general use. The high speed paddle type (Cherry-Burrell) and the direct injection of steam type (Cooney). Both are subject to deposits caused by high temperature and should be checked closely. The Cooney pasteurizer is a series of jacketed pipes that should be dismantled for inspection. Even with efficient operation, it is likely to become heavily coated with baked on deposits. High temperature heating of milk always means additional difficulty in cleaning operations.

Vats used in the creamery are usually "coil vats" because of their flexibility of operation and the thorough agitation obtainable by the use of coils. Coil vats present a special sanitary problem. It is a difficult task to keep equipment free from alkali deposits when neutralizers are added as a regular procedure. It is difficult, also, to reach under the coil and clean the bottom of the vat so, in many instances, cleaning operations in coil vats are not thorough. The packing boxes on the ends of the coil should be checked closely to see that they fit tightly and do not allow leakage. This is also a likely area to be missed in washing. Dirty vat coils are quite common, in otherwise well-managed creameries.

As in the milk plant, sanitary pipes should be dismantled and cleaned daily. They should be of stainless steel or well tinned copper and should be free from milk stone.

FIG. 18. GRADING BUTTER

In one respect at least the illustration shows what not to do. A finger is not a proper instrument for sampling butter. Flavor is the most important factor in selecting butter for army use. It is given a weight of 45 in a total of 100 points. Flavor is a combination of tastes and odors and a multitude of oral sensitivities—touch, heat and cold. The ability to recognize flavors by taste must be cultivated by practice as surely as any of the other special senses—the touch of the surgeon, the "ear" of the musician, the keen sense of smell of the scout, etc.

Dissembling and cleaning the pipe only once a week is practiced in some otherwise well managed creameries. Between cleanings, live steam is forced through the pipes each day, at the close of operations. This practice is inadequate for good sanitation and probably does not save any time since it requires a great deal longer to clean pipes that have been used for a week than to clean those used but a day. Even live steam, unless its application be for a considerable period, will not destroy bacteria protected by the heavy deposit of milk stone that accumulates in pipes, which are cleaned only at weekly intervals. The live steam bakes this coating on to the pipes so firmly that its removal is rendered very difficult.

As stated in the discussion of fluid milk plants, cleaning sanitary piping with a hand brush mounted on a 10-foot rod is a tedious, tiresome task, unlikely to be thoroughly done. A rotary, motor-driven brush is not only a desirable, sanitary appliance, but a profitable investment as well. A creamery manager who objects to installing such equipment is suspected of not intending to keep his sanitary piping clean.

Churn sanitation is often a greater problem to the operator than it is to the inspector. The churn may look clean and in good condition, but may be contaminated with molds and yeasts. A clean smelling churn with tight fitting interior construction that is free from visible residue is what the inspector looks for. Loose vanes, rollers or forming boards allow for accumulation

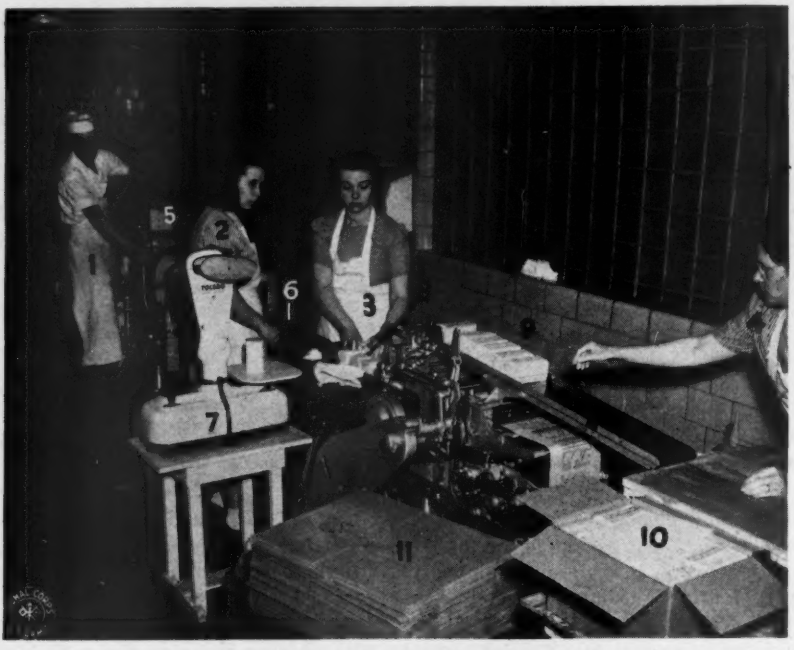


FIG. 20. PRINT (CUTTING) ROOM IN A CREAMERY

(1) Operator of the print machine. (2) Operator of the cutter and weigher. (3) Feeder of the wrapping machine. (4) Packer. (5) Print machine. (6) Conveyor that transports one-pound prints from cutter to wrapping machine. (7) Scales. (8) Butter entering the wrapping machine. (9) Wrapped prints emerging from the wrapping machine. (10) 32-lb. cartons of butter. (11) Empty butter cartons. The employees in this room should wear neat, clean uniforms; not street clothes. All should wear caps or hairnets. From a sanitary point of view, machine wrapping of butter prints possesses distinct advantages over hand wrapping. Machine wrapping brings fewer than half as many employees into the print room and entails much less handling of the butter. In addition the machine does the work better than any but the most skillful. Printing and wrapping should be carried on in a room not used for any other creamery processes and one through which other employees do not pass in their work. Note the glass brick for light and the smooth tiled walls and floor. The interior of this room fulfills the promise of Fig. 5 of good sanitary construction

of residue and furnish a favorable site for the growth of molds and bacteria. Churns should be washed with an alkali solution and rinsed with boiling water.

Butter drawn from the churn should be handled in a sanitary manner; either packed in parchment paper lined tubs or placed in movable racks and covered with parchment paper. It should be protected from gross air contamination and kept in cold storage prior to printing. Stacked tubs should have wooden covers and the tubs themselves should be scrubbed thoroughly before being re-used.

Workers in the churn room should wear clean white uniforms, including caps. The common custom among these employees of working stripped to the waist and with hair flying results in admixture of both perspiration and hair to the butter.

In the finished product, the growth and multiplication of pathogenic and putrefactive bacteria is probably not important, but at least some species of such bacteria (brucella, typhoid, tuberculosis organisms) retain their virulence for long periods in butter. The high percentage of salt and fat in comparison to the amount of moisture present is not conducive to bacterial growth. Nevertheless, care should be taken to handle the finished product in a sanitary manner.

Cleanliness in the print room (cutting room) is mandatory. This operation should be carried out in a separate room with adequate equipment. Printers should be cleaned at the end of every run, and the floor should be scrubbed. Wrappers should be stored in a suitable place and kept in the original boxes until they are used. Machine wrapping is the more sanitary, but if hand wrapping is employed, the hands of the workers should be clean and sterilized in a chlorine solution at intervals. They should wear clean, white uniforms and caps or hair nets. Their street outer clothing should not be worn in the print room.

FIG. 21. TABLE IN THE CONTROL LABORATORY OF A CREAMERY

Cold storage requirements are the same for butter as for fluid milk; 40°F. is sufficient unless it is to be kept for a long period. A dry cold atmosphere is desirable.

Odors in dairy plants are a great aid to the inspector in detecting insanitary prac-

tices or unclean equipment. A foul smelling interior indicates insanitary conditions. The injunction "follow your nose" is a good thing to remember; usually it can be relied upon to detect gross insanitation.

Sample Report of Sanitary Inspection of a Creamery

1. This plant is engaged in the processing and marketing of sweet cream, sweetened condensed milk, bottled fluid milk and the churning and marketing of both sour cream and sweet cream butter. The butter production averages about 75,000 pounds monthly.

2. Site: The plant is suitably located with adequate space, light and air movement, but the lot is littered with old boxes and other waste materials in places several feet deep, obviously the accumulation of months, if not years. The building is a one-story brick in front and two-story frame in the rear, neither part is in good repair. It is not well suited to the manufacture of any type of dairy product.

3. Interior of building: The building is poorly constructed throughout; lighting poor and inadequate; insufficient space for sanitary operation; floors uneven, with many cracks and breaks and thoroughly unsanitary and pools up to four inches deep due to clogged drains. The walls and ceilings are badly in need of paint, the surfaces being dirty with visible pealing and dropping. Division into rooms for separating operations is lacking.

4. Water and sewage disposal: The water is from private wells, supervised by the State Department of Health and ———— Engineering Company. Toilets are available and fairly clean. The sewers and drains are in poor condition; one being clogged and unusable. No provision is made for drain screens and traps.

5. Equipment: Most of the equipment is in a run down, unsanitary condition. Of four vats only one is capable of being properly cleaned and rendered sanitary.

a. The weigh tank is in fairly good condition. It is used for fluid milk and milk used in the manufacture of sweetened condensed milk.

b. The cream for churning is handled in a very unsatisfactory manner. Open dumping into an unsanitary trough is practiced and it is carried to the vats by poorly tinned spouts.

c. A preheater is used in some operations. It should be rebuilt or replaced. It is tarnished with large areas of bare copper and brass exposed. The rubber gaskets are in an extremely unsanitary condition.

d. The milk piping, except for one line that feeds the vacuum pan in condensed milk production, is completely unsanitary. Most of the pipe is untinned and lacks thorough cleaning daily. The separators are in good condition and fairly well cleaned.

e. The churn barrel is new and in good condition. Churning procedure seems to be carried out in careful manner. The commendable operations in churning are completely negatived by unsanitary methods of handling the cream (5 b.).

f. Two stainless steel vats are used in the processing of fluid milk and the processing of sweet cream. These vats are in excellent condition and well cleaned.

g. One pasteurizer is a tinned copper spray vat, a type unacceptable, because the outlet valve does not permit of thorough pasteurization.

h. Two old tanks removed from truck beds are used as storage tanks for the production of skimmed milk and sweetened condensed milk. The interiors of these tanks are not easily accessible and are in a very unsanitary condition. The use of them should be discontinued forthwith.

i. Condensing operations were not checked closely, but the pan and connecting pipes are in fairly good condition. Can washing operations were not observed.

j. The print room equipment consisted of a late model Doerning printer. It was in use when inspected and seemed to be in good condition and clean. Hand wrapping is employed and ample provision is made for the employees to wash their hands. The wrappers wore street clothing which was not clean, in all instances. No provision was made for covering hair of women employees in this room. Male employees wore their street hats.

k. Storage facilities are poor. The ceiling of the cooler is of bare cork and there is continual dropping of particles. The floor is as unsanitary as in the rest of the plant and cracked and wet.

l. Unsanitary practices are the rule throughout this plant due in part to the type of personnel employed. More rigid supervision and control of employees would benefit the whole situation, and particularly a good "Saturday" scrubbing and cleaning would give them and the whole plant a different atmosphere.

6. It is believed that neither milk nor cream nor any derivative of either can be processed in this plant in a sanitary manner even by thoroughly trained personnel and further that most of the present employees cannot handle dairy products satisfactorily without additional training, more careful supervision and stricter discipline than now obtains. This does not apply to the butter maker, the pan operator, one miscellaneous employee, and the acting superintendent all of whom appear to be entirely competent.

7. The general manager of the plant is thoroughly cooperative and anxious to supply the army with the kind of products it wants. His attitude is shown by his entire willingness to supply more than 6000 pounds of sweet cream butter to replace an equal amount of butter offered by other creameries

but which did not score 90. This sweet cream butter would, of course, have been supplied on this army contract at a financial loss to the creamery.

8. The acting superintendent has been employed on a temporary basis to put the plant in a sanitary condition and train the new employees in sanitary methods. He has been with the plant three weeks and so far has:

a. Let a contract for painting the interior of the building at a cost of $1050. This will constitute a valuable improvement.

b. Made arrangements for new floors. This is a badly needed reconstruction.

c. Obtained a priority for new sanitary pipe throughout the plant and a new pump.

He states that adequate competent help is practically unobtainable. Contemplated improvements, which comprise almost re-equipping the plant, will probably help to solve the labor problem and will contribute not only to improved sanitation but may increase the efficiency of the employees as well. . . . . .

. . . . . .

11. Recommendations:

a. Replace all sanitary pipe.

b. Replace three pasteurizing vats.

c. Replace the preheater and the cream dump vat.

d. Provide clean outer garments for the employees.

e. Replace the two storage tanks for skim milk.

f. Relay the floors.

g. Paint the plant inside and outside.

h. Plaster the walls of cooler and repair cooler door.

i. Institute better sanitary methods of handling products throughout the plant.

j. Institute better discipline among employees and as promptly as possible employ more intelligent workmen.

k. That if and when the whole interior of the plant is cleaned, a new cream dump tank obtained, thorough daily cleaning instituted, clean outer garments worn by the butter wrappers, and better discipline enforced for all employees that the plant be approved for the supply of butter for the Army pending the time improvements now planned are being made, provided they are made as promptly as circumstances will permit.

Inspector

FIG. 22. LECTURE ON VETERINARY FOOD INSPECTION

A class of army medical officers taking a course in epidemiology in the school of public health at one of the state universities spent one day at a nearby army post to observe practical demonstrations. The illustration shows the class assembled in the office of the Station Veterinarian for a description of how the veterinary service of an army post assures a safe, wholesome, palatable, sanitary food supply for the troops. Following this discussion the class was broken up into groups of three or four and taken through the post cold storage plant where they were able to observe the methods of selection and handling of all perishable food products

The Milk Condensery

The condensery and its sanitary operation presents some unique problems that the milk sanitarian does not encounter in any other type of milk factory. In this phase of inspection, the dairy and canning industries are brought together in combined operations. Evaporated milk, as a finished product, is usually sterile or contains few bacteria, which means that any insanitary conditions that may be present are countered by sterilization of the product after canning. But the fundamental reason for food sanitation is the elimination of conditions that might possibly be harmful to the product or the consumer and to improve its palatability. Further, esthetic objections to uncleanly practices are a potent limiting factor in the use of any food and must be given weighty consideration if the nutritive value of the product is to be translated into human nutrition. So sanitary regulations for the condensery should be almost as rigid as those governing the production and processing of fluid milk. Fortunately, condenseries must observe sanitary practices in considerable degree to produce a product that will meet their requirements. Bacterial growth in the raw milk must be limited or chemical action during forewarming and sterilization will cause defects that make it unmarketable as an evaporated product. The necessity for a high quality

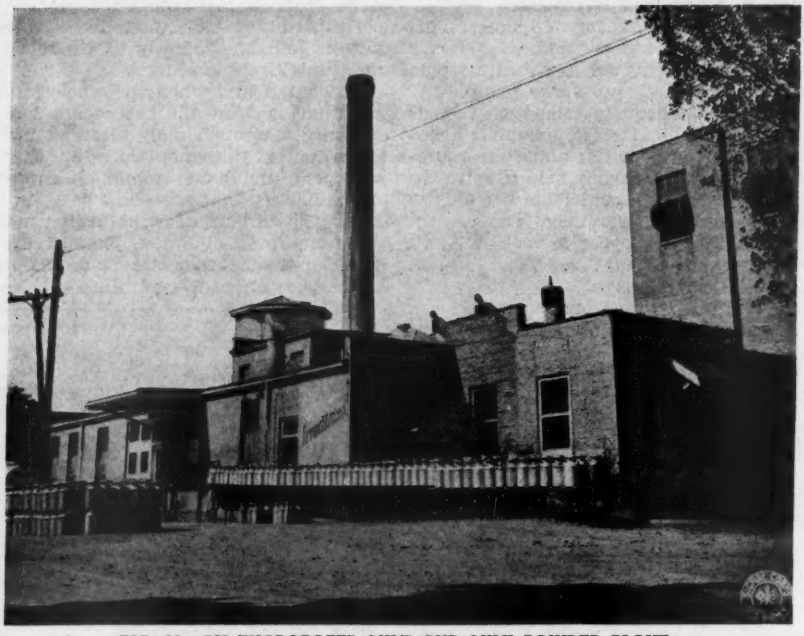


FIG. 23. AN EVAPORATED MILK AND MILK POWDER PLANT

The evaporated (condensed) milk and the milk powder industries (they are to a large degree combined in the same plants) are distinctly "big business". The investment required for plant and equipment is large. The tonnage of milk processed at a single plant far exceeds that of the average creamery or fluid milk plant. The milk is received in part in cans (hauled by company trucks from dairy farms within a 50-mile radius and in tank trucks from more distant collecting stations). The army purchases a hundred millions of pounds of "milk, evaporated," and of milk powder monthly. The one-story building in the illustration houses the equipment for processing evaporated milk and preliminary steps in the manufacture of milk powder; the taller building in the rear is used exclusively in the milk powder production. The tank trailer at the extreme left and the tank truck towing it have just discharged several thousand gallons of milk. The empty cans await a truck driver who is having his lunch. A plant of this size can process a half million pounds of fluid milk daily

product makes it comparatively easy for the inspector to get cooperation in maintaining sanitary regulations. Inadequate fly control, or none at all, is the most common insult to sanitary conceptions, in milk condenseries.

Condensing operations may be divided into the processing of the milk and the canning and sterilizing of the finished product. Factors in the canning process govern some of the steps in the handling of the milk, but the two processes are basically distinct, in fact the processed milk may be diverted either to a canned or a powdered product.

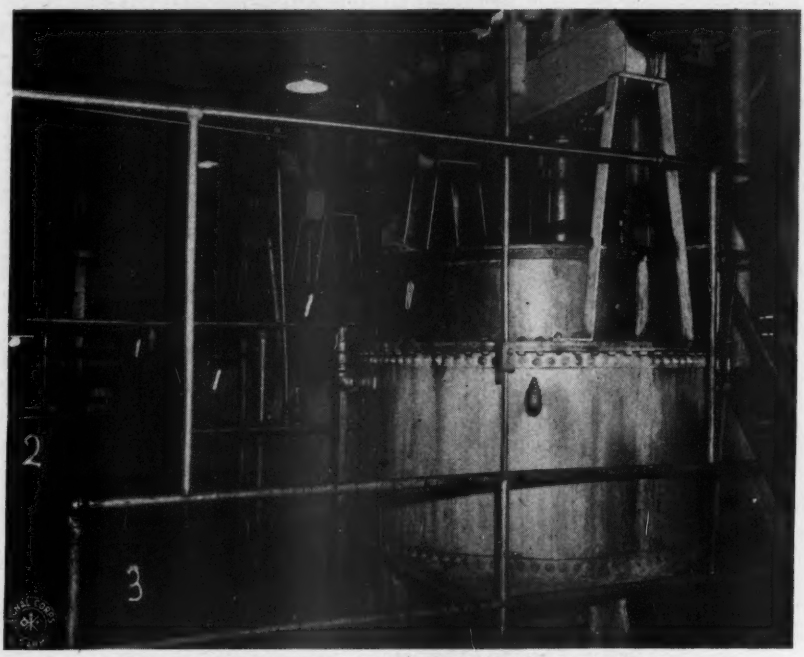


FIG. 24. THE "KITCHEN" IN AN EVAPORATED MILK PLANT

In the center of the illustration (1) from front to rear four hot wells are shown. A small heat exchanger (2) may be seen in the rear at the left. The large tank (3) in front of the heat exchanger is a sterilizer for sanitary pipes and other equipment

In the processing for evaporated milk or milk powder; receiving, separation, clarification, cooling and low temperature storing are, in most instances, identical with those processes in fluid milk operations. Pasteurization of raw milk destined for evaporated milk, milk powder, condensed milk and sweetened condensed milk is supplanted by heating it in a forewarmer called a "hot well." This treatment is carried on at a higher temperature than pasteurization and is accomplished by direct injection of steam or by high pressure steam jackets fitted onto the hot well. In this step it is important to see that all equipment is clean and that there is some means to insure that foreign material is not deposited in the milk through the steam lines. Traps are available that will remove boiler scale, oil and other materials, often present in the steam line. Hot wells should be provided with covers. If they are made of untinned copper, they must be cleaned thoroughly after several hours of operation. Sometimes two hot wells are connected to a high temperature preheater and used to supply the vacuum pans in a continuous operation. If the inspector meets a situation like this, close attention should be paid to the preheater. It is difficult to clean and each tube should be checked for milk stone deposits.

Vacuum pans present no particular problem other than cleanliness—the basis of all sanitation. On some of the new type pans

there are heating flues that resemble preheaters and present the same problem of cleaning and sanitation.

Canning operations are thoroughly supervised by most manufacturers and there are several mechanical devices and methods to insure proper canning procedure. The only thing for the inspector to determine is the cleanliness of operation and the thoroughness of the "clean-up." Check all removable parts and each individual cylinder on the filler. Also, in the case of the Dickerson filler, the flow tubes from the hub to each cylinder should be checked.

Sterilization of the canned products neutralizes almost any bacterial contamination connected with the process, so sanitary requirements are not as rigid as those for fluid milk; however, no unnecessary contamination should be permitted.

Sterilization is of two types, batch and continuous. Either process should be observed by the inspector to determine the temperature used and the length of time the cans are exposed to that temperature. A temperature of 242°F. for 15 minutes, or 10 minutes at 247°F., is relatively standard but there are variations in different condenseries and within the same condensery when the characteristics of the milk demand it, i.e. at different seasons. A sound can of milk that will keep for a long period of time without spoiling is the best indication of satisfactory canning operations. The spoilage of any considerable number of cans of milk during the incubation period is an indication of faulty processing and that later deterioration in the batch may be serious.

In any milk canning operation a percentage of the cans are defective or the soldering, after the cans are filled, is imperfect. The inspector is, of course, keenly interested in the efficiency of the methods used to detect and eliminate such cans since, if they are not removed, the finished product will inevitably contain a greater or lesser

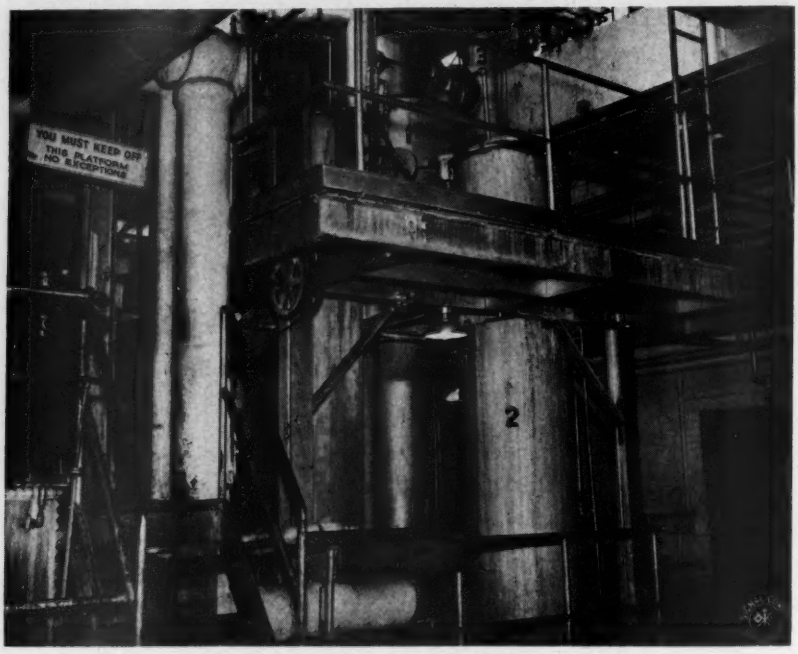


FIG. 25. DOUBLE PHASE CONTINUOUS VACUUM PAN

(1) Vacuum pan (second phase). (2) Steam chest (heating flue). (3) Condensor for moisture evaporated from the milk. This whole vacuum pan assembly is installed immediately adjacent to the hot wells shown in Fig. 24. This illustration and the one that follows indicate the vast amount of equipment required in the processing of evaporated milk and the complexity of its arrangement

number of cans of spoiled milk.

Ingenious mechanical and electrical devices remove at least 90% of these defective cans before they go into storage. The remainder can be found only after a period of incubation—10 days at temperature of 80 to 85°F. is the usual period. Where the urgency of the need for the milk makes it necessary to purchase and ship the milk immediately after it is processed (this sometimes happens in wartime) some spoilage must be expected as unavoidable. In such instances it is especially important to the inspector that he assure himself by frequent inspection, that the automatic eliminators of defective cans are operating properly.

The following blank, used by plant superintendents of one of the large condenseries on weekly check up of the plants, is indicative of the questions the veterinary officer will ask himself in making an inspection of plants producing evaporated milk. It indicates the things he will examine in making a sanitary inspection of the plant. The sample sanitary report that follows it was probably made up after a similar inspection. It will be noted that the sample report does not mention all equipment examined but only the most critical from a sanitary point of view. The omissions are in the cause of brevity.

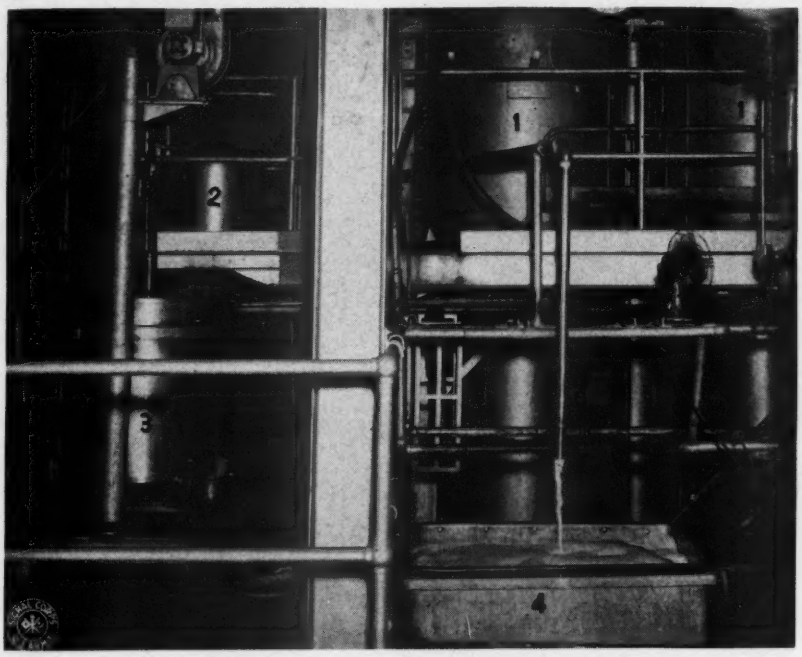


FIG. 26. VACUUM PAN AND IRRADIATOR ASSEMBLY

(1) Double phase continuous operating vacuum pan assembly. (2) Accumulator tank for the irradiator. (3) Irradiator (core removed). (4) Accumulator tank for the homogenizer. It should be covered during operation to prevent atmospheric contamination. The homogenizers (not shown) are below the accumulator tank

There have been instances where evaporated milk companies, usually those new in the business, have established receiving stations near distributors of fluid milk and have accepted (at a lower price) milk that the latter had rejected because of a high bacteria count or inadequate equipment on the farm producing it. This results not only in the use of an undesirable product but is also a hindrance to the improvement of the raw milk supply in that locality and justifies the army inspector in rejecting the output of the plant.

Plant Superintendent's Weekly Inspection

PORCH

1. Driveway clean condition?.....
2. All loads covered?.....
3. Receiving room clean good condition?.....
.....
4. Acidity from Brom Cresol test in use?.....
.....
5. Can washer clean?.....
All spray heads working properly?.....
Raw milk sampler in good condition?.....
8. Receiving tank clean?.....
In good condition?.....
9. Babcock test room clean?.....
Equipment in good condition?.....
Glassware clean?.....
Sample bottle and corks free from mold?
.....
10. Pump and milk lines to storage tanks clean?.....
In good repair?.....

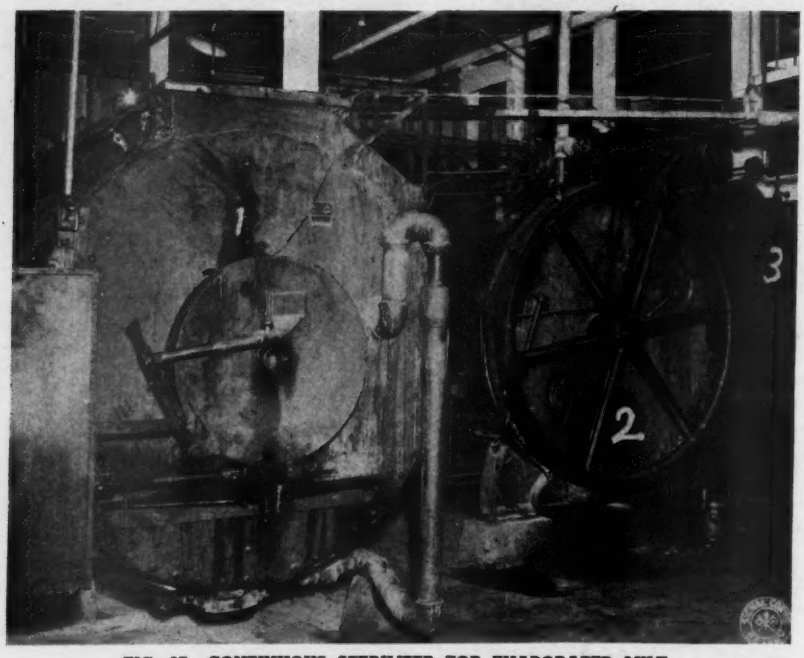


FIG. 27. CONTINUOUS STERILIZER FOR EVAPORATED MILK

Immediately after it is sealed in cans, evaporated milk is put through a sterilizer. Usually the six-ounce and the eight-pound cans are sterilized in a batch sterilizer, the 14-ounce cans in a continuous sterilizer. The illustration shows an Anderson-Barngrover continuous sterilizer. It comprises three large and very long tanks. The one on the left is the preheater (1), in the right center the "cooker" (2) and on the extreme right the cooler (3). In the center tank the milk is raised to a temperature of about 245°F. In addition to sterilizing the milk, this process has much to do with the color, flavor and "body" of the finished product. The milk is not always sterile when it comes out of the sterilizer but usually becomes sterile within a fortnight afterwards. The growth of bacteria in evaporated milk during and after the incubation period is, in nearly all cases, due to imperfect sealing. Dented cans are a fruitful cause of imperfect sealing and should be regarded with suspicion

Inspection of cans from can washer
(Dirty.....%) (Rusty.....%)
(during 15-minute inspection)
(Not dry.....%) (Broken Seams.....%)

6. Weigh tank clean?.....
In good repair?.....
All strainers clean?.....
In good repair?.....
Valves on weigh tank clean?.....
In good repair?.....
7. Milk trough or conductor clean?.....
In good repair?.....
11. Fresh milk storage tanks clean?.....
In good repair?.....
12. Fresh milk storage room clean?.....
In good repair?.....
13. Milk lines and valves, tanks to hot wells clean?.....
In good condition?.....
14. Separator clean?.....
Equipment used in separating clean?.....
In good repair?.....

KITCHEN

1. Were the following in clean, sanitary condition?
   Pan platform?.....Floor?.....Sewers?.....
2. Hot wells clean?.....
   Tinning good condition?.....
   Milk lines and valves, hot wells to pans clean?.....
   In good repair?.....
3. Preheater clean?.....
   Line to preheater?.....
   Preheater pump?.....
4. Pan well cleaned?.....
   In good repair?.....
   Dome and gooseneck well cleaned?.....
5. High temperature forewarmer clean?.....
   Lines to pan?.....
6. Milk lines and valves, pan to drop tank clean?.....
   Continuous pump clean?.....
   In good repair?.....
7. Strainer on line to drop tank clean?.....
8. Filters clean?.....
9. Irradiator clean and in good operating condition?.....
   Lines to homogenizer clean?.....
10. Were following clean and in good repair:
    Homogenizer?.....Strainers?.....
    Milk line to cooler?.....
    Homogenizer return line?.....
11. Cooler clean?.....In good repair?.....
    Surroundings of cooler in clean, sanitary condition?.....
12. Pump and lines, cooler to storage tanks clean?.....

STORAGE TANK ROOM

1. Storage tank room in clean, sanitary condition?.....
   Properly lighted?.....
   Valves and lines to filler clean?.....
   Storage tanks clean?.....

FILLER ROOM

1. Float tank clean?.....
   In good repair?.....
   Filling machine clean?.....
   In good repair?.....
2. Floor and surroundings of filler in clean, sanitary condition?.....

GENERAL

1. Is all sanitary pipe equipment clean?.....
2. Are all water and steam lines disconnected from milk lines during manufacturing operation?.....
3. Dressing-rooms, toilets and shower bath kept in clean, sanitary condition?.....
4. Pan and vacuum loss in ten minutes?.....
5. Any evidence of insects or rodents in plant?.....

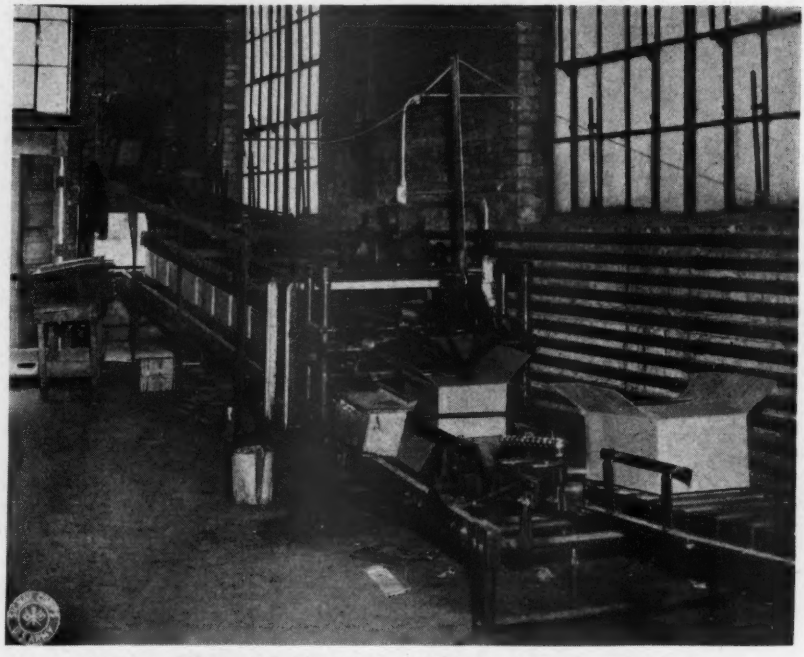


FIG. 28. SEALING MACHINE FOR CARTONS OF EVAPORATED MILK

The carton on the right is being transported on a conveyor from the mechanical carton filler, the one in the center is just entering the sealer and the row of cartons to the left are being conveyed to a railway freight car outside the building. Hand labor in loading is employed only to stack the cartons in the car.

Sample Report of Sanitary Inspection of an Evaporated Milk Plant

1. *General.*—This plant is located in an outlying, industrial section. The plant processes and cans evaporated milk in 14½-ounce and six-ounce cans. Milk is received by tank truck from receiving stations and also in cans from nearby farms. Ice cream mix is also manufactured at this plant, but not for the supply of the armed forces.

2. *Building.*—The building is of one and two story brick and wood construction. The one story section containing the receiving, processing, canning, and sterilizing rooms. The two story section contains the office, laboratory, warehouse and labeling room.

3. *Interior construction of building.*—

a. Walls: The walls in the receiving, processing and sterilizing rooms are of painted brick construction. The walls of the filling room are of glazed yellow tile.

b. Ceilings: The ceilings are constructed of painted wood with beams and rafters showing. The paint is peeling from most of the ceiling in the one story section. Some repainting has been done within the last two weeks.

c. Floors: The floors are of concrete, well pitched, with an adequate number of drains in the processing rooms.

d. Ventilation: The ventilation is satisfactory.

e. Light: Both natural and artificial lighting is satisfactory.

f. Toilets: The toilets are easily accessible. Hot water, soap, and paper towels are available. There are signs on the doors admonishing the workers to wash their hands before returning to work. The entire room is clean. There are no double doors between the toilets and outer rooms.

g. Water Supply: Deep wells, under company supervision, supply the water for the plant.

h. Doors and Windows: Some of the doors and windows are not screened. Fly control is not adequate.

4. *Equipment.*—The equipment, in most cases, is old, and some of it is badly worn, making cleaning operations difficult. The management states that new equipment is unobtainable at the present time because of market conditions.

a. Receiving Equipment: This equipment is in fairly good condition, although old.

(1) Weigh and dump tanks: These are of tinned copper. The dump tank should be rebuilt or replaced. The edges are battered and rough, making it difficult to clean.

(2) Can washer: This is a Lathrop-Paulson straight-away type. It is in good operating condition; the cans emerge hot, clean and dry.

b. Processing room equipment:

(1) Glass lined storage tank for raw milk: This tank is in good condition.

(2) Heat exchanger: This is of stainless steel plate construction, and is in good condition.

(3) Hot wells: There are four copper hot wells with stainless steel covers. They are in fairly good condition.

(4) Vacuum pan: This is a Buffalo-Vac, double phase, continuous operation pan, with a capacity of 22 thousand pounds per hour. It is of stainless steel construction and in good condition.

(5) Pumps: These are of bronze construction and in fairly good condition.

(6) Piping: Sanitary piping of stainless steel or tinned copper construction is used throughout. Most of the piping is in good condition, although some lengths should be replaced.

(7) Homogenizers: There are two six-cylinder homogenizers of old design but in fairly good operating condition.

(8) Irradiator: This is a stainless steel, carbon arc irradiator manufactured by the Creamery Package Company. It is in good condition.

(9) Cooler: A tubular surface cooler and aerator is in fairly good condition.

(10) Storage tanks: There are three stainless steel holding tanks; all in good condition.

(11) Fillers: There are two 14½-ounce fillers and one six-ounce filler. All three are in good sanitary condition. A water bath is used for detecting improperly sealed cans.

(12) Sterilizers: An Anderson-Barngrover continuous sterilizer is used for the 14½-ounce cans. There are two retort sterilizers for the six-ounce cans. The sterilization temperatures are satisfactory.

5. *Incubation.*—The finished product is incubated at room temperature in the warehouse prior to delivery.

6. *Plant Operations.*—

a. Maintenance of Sanitary conditions:

(1) All equipment is clean, showing evidence of thorough daily cleaning operations.

(2) The product is made according to accepted sanitary proceedings and practices.

b. Objectionable Practices:

(1) The outside door of the receiving room is often left open during plant operations.

(2) The hot wells are operated with the covers open.

7. *Recommendations.*—

a. It is recommended that all outside apertures be screened and fly control instituted immediately.

b. That the hot wells be operated only with the covers closed.

c. That the painting of the ceiling be completed.

d. That the plant be approved as a source of evaporated milk for the Army contingent upon prompt compliance with subparagraphs a and b of paragraph 7.

Capt. V.C.

The Ice Cream Plant

The ice cream factory seldom receives raw products directly from the farm, unless it is operated in conjunction with some other type of milk plant; e.g. a fluid milk plant or creamery. Its operation can be divided into two separate processes: (1) the manufacture of the mix and (2) the freezing and the hardening of the finished product. These processes may be, and often are, carried on in different plants; sometimes hundreds of miles apart.

zation pressure varies from 2000 to 3000 pounds.

Because of the high temperature of pasteurization and the low temperature at which the product is stored, supervision of ice cream plants has been rather lax in most instances. All equipment and utensils should be inspected as for a milk plant. Ice cream is a food product and sanitary conditions and practices should prevail, regardless of the fact that the finished product

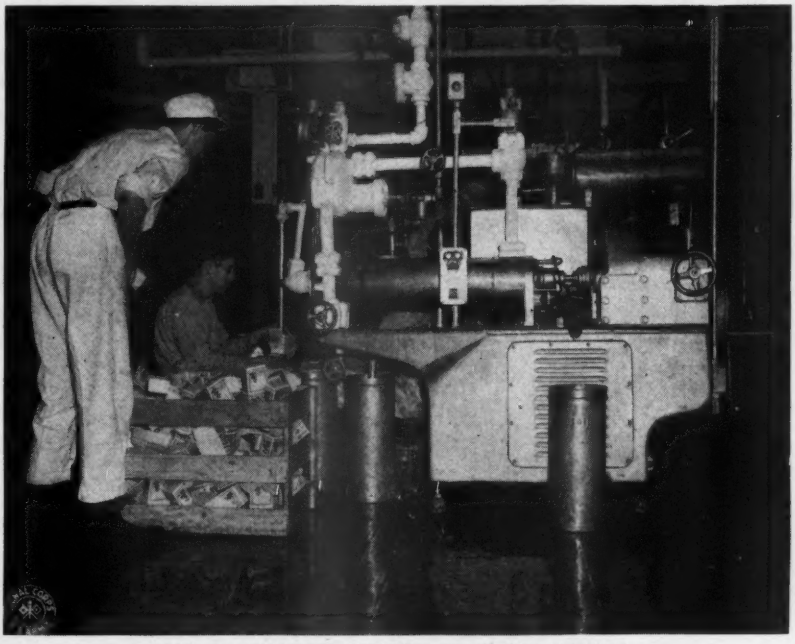


FIG. 29. VOGT CONTINUOUS ICE CREAM FREEZER

Sanitary inspection of an ice cream plant must include also an inspection of the conditions under which the mix is prepared, often in a different plant sometimes as much as 100 miles or even farther away. The operation shown in illustration is subject to criticism for having the cartons on the floor where water might be splashed upon them. The rubber boots worn by the helper show the likelihood of contamination of the product in this way. The "tonnage" of ice cream consumed by the Army is surprisingly large

In the first process, the manufacture of the ice cream mix, milk products are subject to the same treatment, by the same equipment as fluid milk, except that sugar and a stabilizer are added at pasteurization, and the mix is standardized to a definite composition. Pasteurization temperatures range from 150 to 170°F. and the homogeni-

will not spoil even if cleanliness is not observed. Freezing temperatures do not destroy all bacteria; but simply inhibit the growth of many types of organisms. Contamination before freezing may cause illness when the product is consumed. Justification for insanitary methods is often urged on the basis that they have been used for a

long period and "the product has never killed anyone yet." The objective of food inspection is to eliminate potential dangers before, instead of after, a catastrophe has occurred.

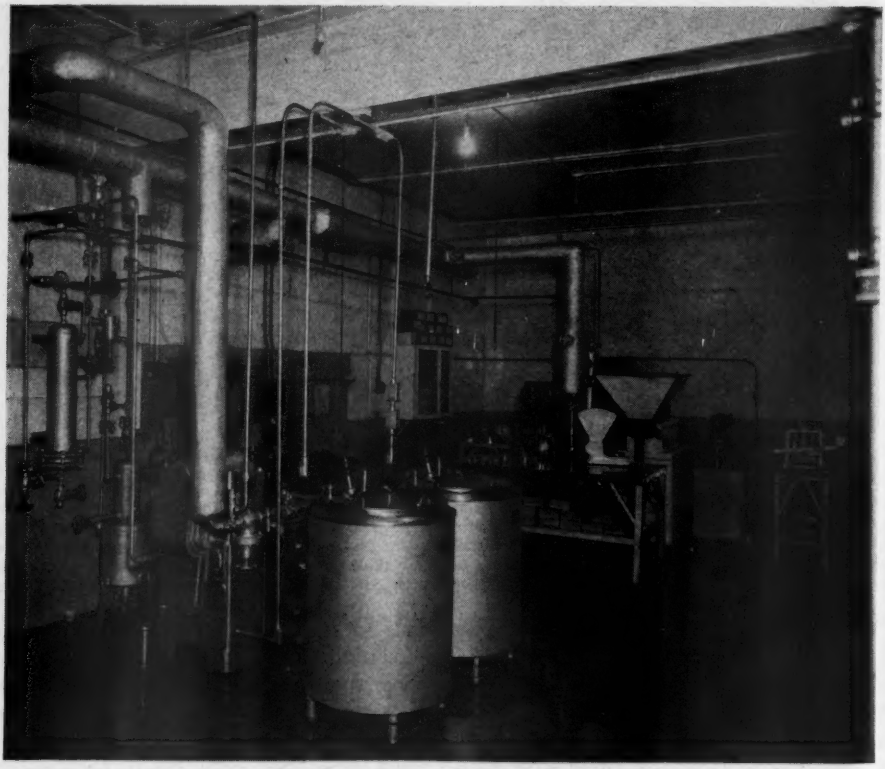
Freezers are sometimes difficult to wash. They should be rinsed with cold and then warm water before they are subjected to a thorough washing with an alkali solution. There are more utensils used in ice cream manufacturing than in the other dairy product operations. Means for washing cans, brick pans, trowels, stirring rods, buckets and dippers should be provided. Chlorine solution for sterilization is indispensable in an ice cream plant. It should be used on all equipment and utensils daily, the same as in other milk products plants.

Ice cream cartons should be kept clean and dry while in storage.

Hardening rooms should be maintained in the same sanitary condition as cold storage rooms in the milk plant.

Where metal cans are used, they should be inspected thoroughly. They should be clean, bright and smooth, with closed, smooth seams and well-tinned joints.

Sugar, fruits, nuts and other products added to the cream should be stored and handled in a sanitary manner. Sugar sacks should be kept off the floor and secure from mice and rats. Gelatin and egg products should be kept in closed containers and under refrigeration. Of course, all of these should be free from foreign material or other contamination.



CORNER IN A LARGE ICE CREAM FACTORY
Showing continuous freezer, univats, packaging machine and brick slicer

The Cheese Factory

In cheese plants, bacterial counts mean little or nothing, due to the induced growth of desirable bacteria. Excessive bacteria counts in the raw milk, however, result in poor quality cheese. Where pasteurized milk is used, the processing of the product eliminates most of the possibilities of pathogenic infection.

Cleanliness is of great importance to the quality of the product. Cheese should be ripened (aged) before it is used, and if there has been gross contamination with undesirable bacteria, it will spoil during the ripening period. Cheese is made with a minimum of equipment in the small factories. In some instances, practices are quaint and peculiar to a single plant although all manufacturers follow certain general procedures.

Cheese should be stored in a cool place for aging and should be inspected while it is cool. Occasionally truck loads arrive at army installations with the cheese very warm. It is best to hold it in cold storage until the next day, before deciding either to accept or reject it. Numerous gas bubbles or gas bubble spaces is perhaps the commonest fault of cheese produced in small factories. It is an indication of insanitary methods of production or improper storage while aging—usually both.

Pasteurization temperatures (where pasteurization is employed) and processing methods vary according to the operator and the type of cheese. There are no special rules for sanitation in the cheese factory—simply the inviolable rule for any food processing plant, that it must be clean. Even though safety, quality and palatibility be not involved, if such a condition could obtain, it still must be clean for esthetic reasons. The consumer should not be tricked into eating a product the filthiness of which would disgust him if he knew of it. He pays his money for a product that he believes is safe, wholesome and clean. To supply a different one is to take his money under false pretenses, even though it may not endanger his life or health.

FIG. 30. GRADING CHEESE

Use of the Laboratory

Some laboratory assistance is essential in food inspection for the Army. Only a laboratory examination can determine compliance with certain legal and contractual requirements; e.g., the percentage of milk fat, total solids and bacterial count of fluid milk, the fat content of butter, the fat and moisture content of cheese, the percentage of moisture, the solubility index and the bacterial count in milk powder, dehydrated eggs, etc.

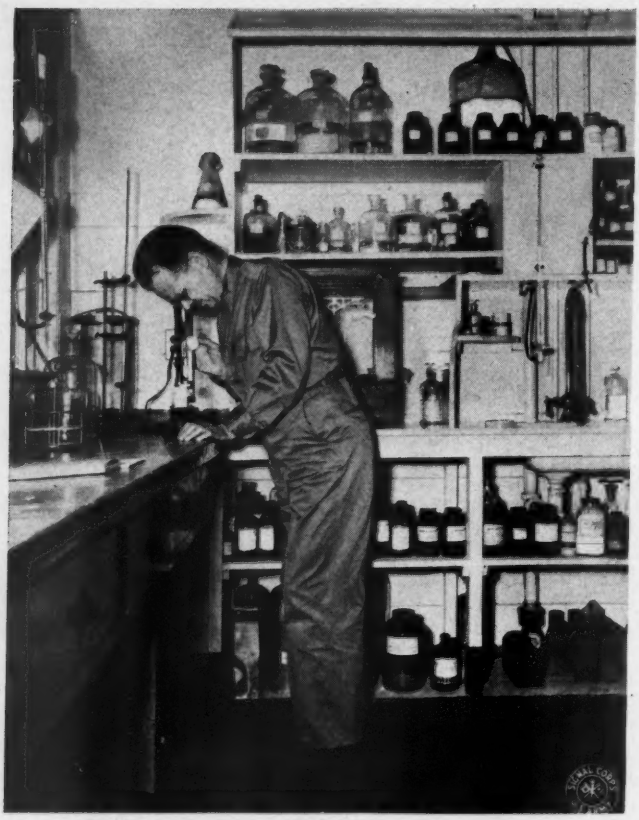


FIG. 31. CORNER IN AN ARMY STATION LABORATORY

To avoid duplication of laboratory equipment, laboratory examination of food specimens for the station veterinary service is made by the station laboratory

The laboratory may render a valuable assistance in sanitary inspection also, particularly when difficulty is encountered in determining and eliminating the source of contamination of a product. Thus when high bacterial counts are obtained continuously, or at frequent intervals, in fluid milk obtained from a plant that has passed a satisfactory sanitary inspection, a bacteriological survey of the plant may facilitate the location and elimination of the source or sources of the contamination or the practices that are responsible for the high counts.

Such a survey may include: (1) Sampling the raw milk of each patron of the plant as it is received. (2) Bacterial counts of the interiors of 5 to 10% of the cans after they are washed at the plant. (3) Determination of the bacterial flora of the interior surfaces of the weight tank, receiving

tanks, holding tank, cooler, pasteurizers, pumps, homogenizer and bowl of the bottle filler and of representative sections of the piping just prior to the beginning of the daily operations in the plant. (4) Bacterial counts of the interiors of bottles obtained at various times during the whole period of bottling. Bacterial counts of raw milk just before pasteurization, of each batch, as it leaves the pasteurizer, as it leaves the cooler and at the bottling machine and also of the skim milk used for standardization. (5) Checking the strength of caustic soda in the washing, in the can washer and bottle washer and the residual chlorine in the rinse, both at the beginning and at the end of washing.

With the information obtained from such a survey the inspector of a fluid milk plant may proceed with more confidence to correct the insanitation or methods responsible for the high bacterial count in the product delivered to the consumer. The following copy of the report of such a survey of a fluid milk plant is illustrative of the information to be derived from a bacteriological survey.

Bacteriological Survey of Blank's Milk Plant*

Bacteria Counts of Raw Milk

No.	Temp.	Microscopic Count	Suspected Trouble**
219	63	60,000	
227	58	12,000	
301	57	75,000	
218	57	90,000	
229	58	12,000	
147	58	12,000	7
125	48	50,000	
125	49	6,000	7
125	49	6,000	7
133	59	150,000	3
135	60	6,000	
131	57	90,000	7
142	54	12,000	
136	51	6,000	
134	59	6,000	
137	56	900,000	1
38	66	12,000	
38	65	80,000	
37	62	20,000	
33	64	600,000	1, 2
34	63	12,000	
36	63	6,000	
35	60	50,000	
206	60	30,000	
215	56	300,000	1, 7
215	56	600,000	1
216	60	90,000	
214	58	6,000	
201	60	6,000	
211	51	30,000	
208	62	30,000	
200	62	70,000	
213	67	400,000	1, 2
202	63	90,000	7
198	63	80,000	
198	63	80,000	7
204	58	6,000	
296	68	100,000	2
209	62	30,000	
69	61	300,000	
311	58	30,000	
66	59	12,000	
63	59	6,000	7
192	59	90,000	
127	63	6,000	
191	66	3,000,000	1, 2, 3, 6
120	58	12,000	
120	57	6,000	
91	63	90,000	
91	63	75,000	
61	59	90,000	
87	60	100,000	1
174	62	12,000	
18	71	90,000	7
179	60	6,000	7
181	59	2,000,000	1
178	60	10,000	
59	60	12,000	
105	61	50,000	
106	63	60,000	
107	59	90,000	
112	58	6,000	
113	59	150,000	1
116	61	6,000	
280	58	6,000	
306	56	6,000	
101	57	6,000	
101	56	30,000	7
16	59	6,000	
16	60	6,000	
266	50	12,000	
310	59	150,000	3
102	56	50,000	7
263	57	6,000	
145	60	6,000	
190	60	100,000	
317	61	12,000	
293	60	90,000	
299	59	6,000	
93	60	6,000	7
92	59	6,000	7
95	62	6,000	
60	58	20,000	
271	53	6,000	
297	58	6,000	
157	62	12,000	
157	61	6,000	
100	60	150,000	1
298	60	6,000	
100	59	90,000	
264	62	60,000	
172	60	50,000	
316	59	90,000	
55	65	150,000	2, 3
288	60	6,000	
291	63	20,000	
183	59	6,000	
90	60	6,000	
90	60	12,000	
86	60	6,000	

**Key.
1. Probably utensils not properly cleaned.
2. Probably poor or delayed cooling.
3. Probably dirt from cows or barn in the milk.
6. Probably udder infection.
7. Cells; probably due to recent or near approaching parturition or to udder injury.

Temperatures of Icebox—Storage

When almost through loading out in morning the machine is defrosted.

7:50 a.m.	Defrosting and loading out.....	52°F.
8:30 "	Started cooling (air circulated)	
9:00 "	Bottled goods coming in.....	37°F.
11:30 "	Bottled goods coming in.....	39°F.
12:00 noon	Bottled goods coming in.....	38°F.
1:30 p.m.	Bottled goods coming in.....	38°F.

*Monthly survey for producer by Dr. C. S. Bryan.

Bottle Washing Checkup

Bottles		Bacteria Count	
1. Sample of caustic		0	
2. Quart	First 8 quart bottles through washer—8:10 a.m.	0	Chlorine in Chlorine tank is just made up and use started.
3. "		10	
4. "		0	
5. "		0	
6. "		0	
7. "		10	
8. "		0	
9. "		0	
10. 1—½ pt. for cream	9:00 a.m.	0	
11. Quart—Just out of caustic	9:45 a.m.	0	
12. " Just out of caustic	" "	0	Outside cooling water dilutes chlorine solution and pump to chlorine jets leaks about ½ pt. per stroke.
13. " Through 1st inside rinse	" "	3000	
14. " Through 1st inside rinse	" "	4000	
15. " Through inside brusher	" "	1200	
16. " Through inside brusher	" "	3000	
17. " Through 2nd inside rinse	" "	800	Chlorine — less than could be found on test maybe 0.
18. " Through 2nd inside rinse	" "	1200	
19. " Through washer (after cl.)	" "	1000	
20. " Through washer (after cl.)	" "	800	
21. 1 qt.—used for Homo	10:20 a.m.	10	Chlorine 20 p.p.m.
22. ½ pt.—Army Milk	11:00 a.m.	0	
23. ½ pt.—Army Milk	" "	0	Added more chlorine by hand. 140 p.p.m.
24. ½ pt.—Army Milk	" "	10	
25. ½ pt.—Army Milk	" "	0	
26. ½ pt.—City delivery	11:15 a.m.	10	
27. ½ pt.—City delivery	11:30 a.m.	0	
28. ½ pt.—City delivery	12:05 p.m.	200	Chlorine 0 due to dilution from overhead cooling rinse.
29. ½ pt.—City delivery	1:45 p.m.	300	
30. ½ pt.—City delivery	1:55 p.m.	200	

Milk Samples

Sample	Bact/cc (living) Frost Plate Count	Milk pasteurized in laboratory Frost Plate Count
1. Fresh skim used for standardization	25,000	
2. Vat 2 raw and standardized 8:45 a.m.	85,000	500
3. Vat 2 past. and cooled partly 10:30 a.m.	200	
4. Vat 2 past. at bottom of cooler 10:55 a.m. (42°F)	250	
5. 1 qt. hood cap milk for army 11:00 a.m.	1,800	
6. Vat 1 Jersey raw 8:45 a.m.	25,000	3,000
7. Vat 1 Jersey past. 9:47 a.m.	1,500	
8. Vat 1 Jersey bottom of cooler	1,500	
9. 1 qt. Jersey 10:00 a.m.	4,000	
10. Vat 5 raw standardized 9:00 a.m.	100,000	5,000
11. Vat 5 heated before homo. 9:40 a.m.	5,000	
12. Vat 5 (in Vat 4) heated after homo. 9:40 a.m.	6,000	
13. Vat 4 past. 10:15 a.m.	4,000	
14. Vat 4 past. bottom of cooler	3,800	
15. Vat 4 out of bottle	8,000	
Raw storage tank sample when full—1:45 p.m.	500,000	
Raw storage tank sample when full—2:22 p.m.	600,000	
16. Vat 3 raw standardized 9:12 a.m.	100,000	3,000
17. Vat 3 past. 11:20 a.m.	2,000	
18. Vat 5 raw standardized 11:00 a.m.	250,000	5,000
19. Vat 4 raw standardized 11:00 a.m.	270,000	5,000
20. Vat 4 past. 1:35 p.m.	5,500	
21. Vat 1 raw standardized 11:00 a.m.	230,000	5,000
22. Vat 1 past. 12:50 p.m.	5,000	
23. Vat 2 raw standardized 12:05 p.m.	250,000	2,500
24. Vat 3 raw standardized 1:35 p.m.	500,000	10,000
25. Vat 1 raw standardized 1:45 p.m.	550,000	20,000
26. Raw skim to use in standardization—11:00 a.m.	200,000	
27. Cream—at separation	100,000	
28. Cream in vat—being bottled—9:15 a.m.	85,000	
29. 1—½ pt. bottle of cream—9:20 a.m.	90,000	
30. 1—½ pt. milk past. June 17 held in icebox until June 18	7,500	

Conclusions.—1. The checks of laboratory pasteurization of vat raw compares favorably with each vat pasteurized except where sample was taken out of bottle—these latter counts and counts of bottles indicate that the washer is not doing an efficient job and contamination is carried over in the bottles.

2. Increase of bacteria count of milk in storage vat emphasizes the need for a cooling device in the vat.

3. The sincerity of all employees is impressive. (*Continued 2nd column, next page*).

Examination of Chlorine Solution

Chlorine solution at weight tank	70 p.p.m.
Chlorine solution after being through all equipment	60 p.p.m.
Strength of stock chlorine solution used at bottle washer	10,000 p.p.m.

Rinse Check of Milk Cans
(40 Qt. Cans)

	Producer	Time	Total bacteria
1.	 147	8:15 a.m.	500
2.	 133	8:40 "	250
3.	 38	8:50 "	250
4.	 216	9:10 "	3000
5.	 178	10:20 "	500
6.	 116	10:30 "	250
7.	 263	11:00 "	5000
8.	 100	11:20 "	750

Swab Check of Equipment

Equipment	Total bacteria
1. Weigh tank	0
2. Dump tank	0
3. Storage tank	10
4. Vat 5 coil	0
5. Vat 5 side	0
6. Vat 4 paddle	0
7. Vat 4 side	0
8. Vat 3 paddle	10
9. Vat 3 side	0
10. Vat 2 paddle	0
11. Vat 2 side	0
12. Vat 1 paddle	0
13. Vat 1 side	0
14. End of pipe—inlet for raw milk at Vat 1	0
15. Side of cooler surface	0
16. Pan under cooler	0

Comment

As indicated by the foregoing bacteriological survey, two lines of action are necessary.

1. Immediately suspend purchases of milk from herds in which the raw milk count was more than 400,000 and prompt inspection of farms with counts ranging from 100,000 to 400,000 with a view to improving the methods and lowering the count to less than 100,000.
2. Require that the bottle washer be repaired at once.

Sediment tests would have made the survey more complete but could be made at a different time more conveniently.

To make the usual laboratory examinations necessary in milk control the veterinary service requires a considerable amount of laboratory equipment, which is not always available to it. If a post veterinary detachment does not possess adequate laboratory equipment for a bacteriological survey of a milk plant, or for the routine weekly, laboratory examination of milk samples, the inspector should collect the samples and take them, properly refrigerated, to the Station Laboratory for examination.

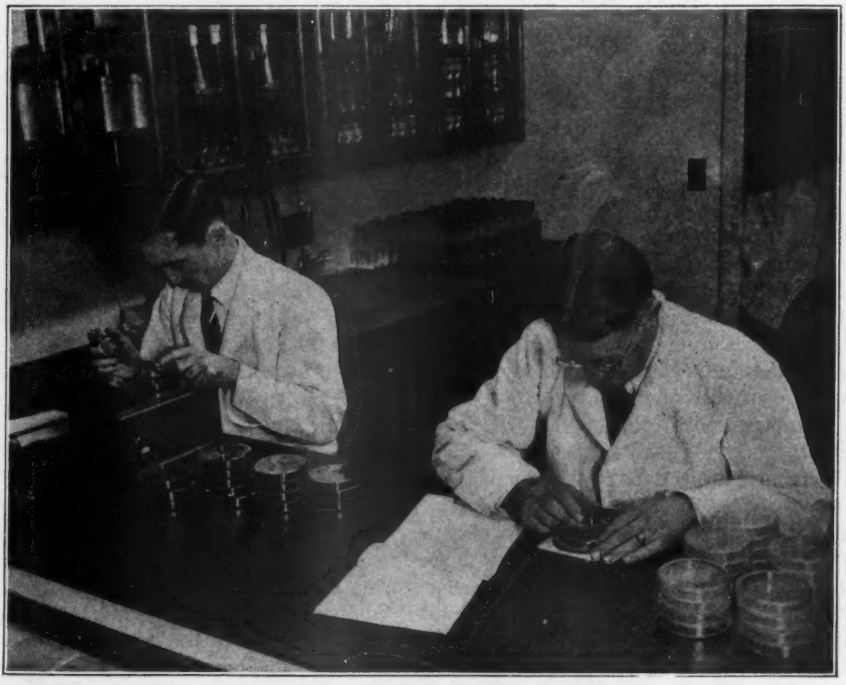


Fig. 32. Bacteria counts of samples of milk, collected on the post at frequent intervals, is the final check on its quality

Dairy Farm Inspection

Nothing in the production of high quality dairy products is more important than good sanitary practices on the dairy farm. Only in highly flavored products such as ice cream and chocolate milk, can objectionable flavors imparted to raw milk on the farm be entirely overcome by processing. The finished product can be made safer than a raw contaminated product but with few exceptions, it cannot be made more palatable. It is true that many adults, habituated to a contaminated milk supply, do not object to the flavor; but it is always objectionable to children and to others not long accustomed to a "barny" or "cowy" or other foreign odor and taste in their milk.

Farm inspection is frequently the weakest link in the sanitary chain that health codes provide for the protection of the milk supply, and where provided for, it is more frequently unenforced than are those relating to milk processing plants; possibly because the latter are usually located on paved streets whereas the dairy farm may be on an unpaved road. The army milk inspector will begin his inspection at the dairy farm and, in not a few instances even in districts which, nominally, have adopted the U. S. Public Health Service milk code and ordinance, he will be the first inspector the dairyman has ever seen on his farm.

Dairy farm inspection presents no difficulties for the veterinary officer, but if his experience in this type of veterinary service is limited, some suggestions as to methods may hasten desirable results. First of all he must have the full cooperation of the dairyman, and usually of the farm wife also, if he is to accomplish much.

Dairy processing plants are relatively few in number; inspections can be made at short intervals. In exceptional cases a representative can be kept in the plant all the time it is operating and this is sometimes done. Further, contracts may be cancelled if satisfactory practices are not maintained. But the farms supplying milk used at a fort or military camp may number in the hundreds. They can not possibly be supervised closely. They can't be inspected daily or even weekly. If the dairyman is not convinced of the necessity or, at the very least, the desirability of the methods he is asked to employ, there is no practical way to force him to comply with them. Fortunately, if he is approached in the right way, there is no one more willing to do his best for the Army or for the public, for that matter. His average intelligence is high, his attitude is usually highly commendable. He is receptive to instruction that is basically sound, but quick to detect the impractical and resentful if his problems are not appreciated. A reason, and a good one, must be given for all changes either in methods or equipment that he is asked to make.

The veterinary officer is always interested primarily, and rightly so, in the health of the herd. The dairyman's interest in this subject is even greater. When a health survey, even if only a visual inspection, is made and suggestions are given for improving the health and efficiency of the herd, the dairyman is already the friend of the veterinary inspector. While the dairyman may put off removing a manure pile, that the cows must wade through to enter the barn, in order to keep the animals cleaner; he will be quick to remove it to lessen the chances of mastitis. Possibly there is no scientific proof that mastitis is contracted from dragging the teats and udders through manure but it is common experience that the disease is more prevalent in herds where this is the practice than in herds corralled in clean lots. The dairyman is interested in learning of this experience and suggestions as to the time of feeding are welcome from the inspector who has won his confidence and has been helpful in other matters. The need for clean udders and clean hands and small-top milk pails at milking time is readily acknowledged when reasons are given, and perhaps supported by a few sediment tests made right before him on the farm, not at the processing plant in his absence. The resourceful inspector can almost always contrive to get some sort

of a milk house provided other than the barn or the family kitchen. Milk cooling and clean utensils can be attained in the same way—by explaining what is to be accomplished by them. Often the farm wife washes the milk utensils. It takes but a few minutes to demonstrate milk stone if present in one of them and to remove it. Then she usually issues a challenge to anyone, to again find other than clean utensils among those she has washed. This naturally leads to the necessity for an ample supply of hot water in the milk house and the need for drain racks, etc.

The experienced inspector will not expect to accomplish everything desirable at his first visit to a dairy farm. He will be satisfied to have remedied the grosser faults; to have won the dairyman's confidence and cooperation, knowing that when the milk shows decided improvement in lower bacteria counts, less sediment and improved flavor he is well on the way to engendering in the dairyman a sense of pride in the production of quality milk. Changes that require a minimum outlay in cash are easiest to get. Methods are far more important than equipment and fortunately changes in methods cost little in either cash or effort.

There are some hangovers from olden days in the sanitary code for the farm dairy, that are at once expensive to comply with and ineffective in materially improving the quality of the milk produced by the dairy. The experienced inspector will ignore them till essential improvements have been attained. An example is the requirement of four square feet of window space for each cow. Artificial light can be better distributed than window light and, in any case, must be relied upon 50% of the time, since that portion or more of the milking is performed during the hours of darkness. Another myth is that windows are necessary for ventilation. Ventilating shafts, less expensive to install, are far superior and furthermore windows will not be opened in severe weather regardless of the need. A third fallacy is the belief that direct sunlight destroys bacteria and "sweetens" the barn. While direct sunlight, which at most reaches but a small percentage of the interior of the barn, will kill bacteria on the surface of a lump of manure, its relative effect is infinitesimal, and as for "sweetening" the barn, a good cleaning followed by scrubbing the floors with lye is 1000 times more effective. A disadvantage of windows is that they make the barn attractive to flies during the summer day, and these pests remain to annoy the cows when they are

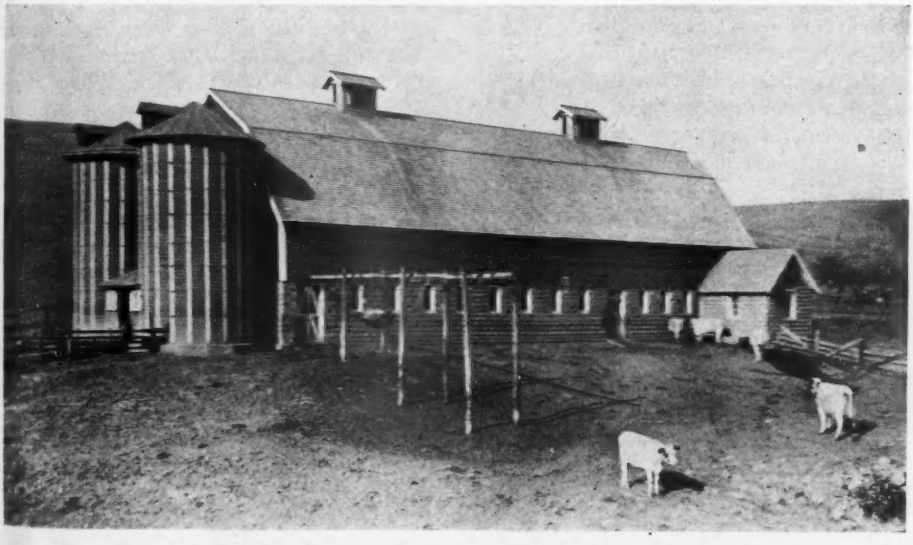


Fig. 33. Good equipment is desirable; good methods are indispensable in the production of clean milk

brought in for milking, strafe the milkers and often fall into and contaminate the milk in the pails.

A white-washed barn interior is a fetish with swivel-chair milk code makers. It possesses both advantages and disadvantages. It makes dirt more conspicuous and thus encourages clean-up operations, which is all to the good, but it needs to be renewed two to four times a year to be effective. On the other hand it is prone to scaling and falling into the milk — carrying with it countless flyspecks and other filth.

The innumerable flies that spend their time impartially in the horse stable, the cow barn, the milk house and the outdoor privy are the prime insult to sanitation on the dairy farm. In season, fly control measures must be pressed unceasingly.

More than strict enforcement of sanitary regulations is usually necessary. Army camps are commonly located some distance from large centers of population and where a sudden influx of 20,000 or 50,000 additional milk consumers may create a demand that exceeds the capacity of the local dairymen to produce. Any attitude of the inspector, other than a cooperative one, will fail of its purpose under these circumstances. If the problem is explained fully to the producers, it is truly remarkable with what speed production can be increased and farm sanitation improved and thus supply the camp without depriving the civilian population.

What can be accomplished by dairy farm inspection is indicated by the following routine reports of the bacteria counts in the raw milk delivered at a fluid plant in May and September of the same year. Between these months all farms supplying this plant were visited by a veterinary officer who explained methods of producing clean milk. No reason, other than improved methods on the farms, is known for the reduced bacteria counts.

Comparison of Bacterial Counts of Raw Milk

Patron	May Count	September Count	Patron	May Count	September Count
13	114,000	12,000	137	60,000	30,000
14	100,000	6,000	144	252,000	6,000
16	24,000	30,000	147	108,000	36,000
22	102,000	150,000	148	66,000	12,000
24	282,000	12,000	152	5,215,000	6,000
26	276,000	36,000	153	18,000	18,000
33	120,000	24,000	154	30,000	12,000
34	156,000	30,000	155	120,000	36,000
35	84,000	18,000	157	108,000	96,000
36	240,000	48,000	166	350,000	18,000
37	240,000	18,000	172	114,000	12,000
41	220,000	42,000	191	312,000	174,000
42	324,000	24,000	192	132,000	18,000
43	444,000	72,000	198	48,000	6,000
44	300,000	18,000	200	36,000	12,000
46	72,000	36,000	201	31,000	24,000
47	168,000	396,000	202	162,000	12,000
48	293,000	12,000	204	24,000	6,000
49	186,000	12,000	207	84,000	54,000
50	600,000	6,000	208	1,400,000	60,000
51	288,000	12,000	209	126,000	48,000
53	250,000	180,000	211	6,000	12,000
54	216,000	24,000	213	108,000	102,000
60	160,000	36,000	214	144,000	6,000
72	108,000	24,000	215	240,000	18,000
73	168,000	6,000	216	72,000	6,000
75	254,000	12,000	218	810,000	24,000
76	190,000	12,000	219	24,000	12,000
78	48,000	126,000	220	300,000	6,000
81	140,000	126,000	221	24,000	42,000
84	108,000	6,000	227	174,000	6,000
86	70,000	18,000	229	288,000	42,000
88	5,460,000	36,000	262	300,000	48,000
91	150,000	48,000	264	120,000	24,000
92	84,000	6,000	268	240,000	18,000
95	108,000	18,000	269	24,000	6,000
100	420,000	30,000	270	456,000	174,000
105	84,000	6,000	271	510,000	36,000
106	114,000	12,000	280	300,000	30,000
107	120,000	24,000	282	300,000	30,000
109	678,000	12,000	285	192,000	36,000
112	237,000	12,000	287	96,000	30,000
113	220,000	12,000	288	132,000	90,000
116	90,000	6,000	296	72,000	30,000
120	222,000	78,000	297	168,000	48,000
125	280,000	6,000	298	162,000	30,000
126	216,000	12,000	301	198,000	48,000
127	1,500,000	54,000	306	300,000	12,000
133	150,000	42,000	311	340,000	42,000
135	168,000	18,000	Avge. (arithmetic)	318,500	38,120

Produce Establishments

In making sanitary inspections of plants supplying dressed poultry and shell eggs for consumption by army personnel, the veterinary service encounters many factors that are seldom met with in making sanitary inspections of meat and meat product plants or dairy products installations. A fluid milk plant, of a size adequate to supply the average army camp, represents an investment of thousands of dollars and is unlikely to be established "for the duration" only. Even a small meat-packing house represents a greater investment and an evaporated milk or milk powder or egg powder factory an outlay running into hundreds of thousands of dollars. In dealing with the owners of such plants the inspectors are dealing with business men of established reputation and usually with men who take pride in the quality of their products, and who understand a contract.

Quite the contrary are the conditions that surround the supply of poultry and eggs to an army camp. Since various special messes (officers' mess, nurses' mess, etc.) and the Post Exchange purchase most of these supplies direct from the dealers (not through the Quartermaster as meat, butter, etc., are obtained), they afford a market for small quantities of dressed poultry and shell eggs. At an outlay of $50 one can embark in the poultry supply business and even less suffices to enter the wholesale egg business. As a consequence, immediately an army camp is established there is a mushroom growth of "produce houses" recruited from all manner of peddlers or other entrepreneurs, who have been engaged in various small enterprises and who see, in the suddenly established market, what they believe to be a chance to make money easily and fast. Few of them possess any knowledge of the produce business. Sanitation is meaningless to them. They haven't the faintest idea of the proper way to kill a chicken, scald it or dress it. To them an egg is something a hen laid; just that. There is a single motivation, to make all the profit possible before the war is over and the camp abandoned. There is no thought of continuing longer in the business, and a natural disinclination to purchase any equipment that they can manage to get along without.

This is not to imply that there are not established produce houses in the vicinity of most army camps or within trucking distance of them. Such houses are usually well equipped, the operators understand the business, their products have an established reputation and their business is conducted on a plane as high as any other. However such houses are interested usually in sales only to the Quartermaster, for the general mess. Orders for less than 10,000 pounds of poultry or 150 cases of eggs mean additional expense for delivery and they do not care, particularly, for orders from the special messes, but leave that trade to the "itinerant dealers," "adventitious suppliers" or by whatever term, those in business for the duration only, are designated.

FIG. 34. ONE OF THE LARGEST OF POULTRY PACKING PLANTS

Poultry Slaughtering

Poultry dressing for the army in the establishments that have been regularly in the business for some time, entails few special problems of inspection. There is just the general requirement of food processing plants that there must be at least one thorough cleanup of the equipment and premises daily and that contamination of the product must be avoided, in so far as the nature of the process will permit.

No poultry slaughtering establishment nor any other abattoir can be clean while in operation, but the blood and offal that litters the floor and other objects can be, and must be, fresh, not left over from the kill of previous days. Blood, manure, wet feathers, etc., have an offensive odor but if fresh, it differs from the putrid odor that proclaims, immediately one enters the room, that the daily clean up has not been thorough. There need not be, and should not be, any putrid odor about the place. Since stress has been laid on the necessity of saving chicken feathers for camouflage and other war purposes there has been a tendency to accumulate these in the abattoir

FIG. 35. TYPICAL PRODUCE HOUSE OF THE BETTER CLASS

Poultry and egg dealers are commonly located in towns or small cities in districts where poultry is a side line on most of the surrounding farms and the principal or sole business on a small minority. Such plants are usually served by a number of small truckers working for the produce dealer on a salary or commission, or operating independently. These truckers have established routes on which they collect the eggs and poultry once or twice a week from the farms. In addition many poultry raisers bring their own produce to the market. The big advantage of being located close to the source of supply is that of getting the eggs into cold storage before they begin to age. Eggs more than a week old are purchased at a discount. In these plants the eggs are sorted, graded and stored as need be and usually marketed to regular customers, chain stores or other retailers, restaurants, hotels, bakeries, etc. Because of intimate knowledge of the market and careful grading, these produce houses are usually able to pay the farmer a better price on the farm than he could get by shipping his eggs ungraded to the central markets. Such establishments are a potent influence in teaching farmers to take better care of their laying hens and of the eggs and they contribute not a little to the prosperity of the communities in which they operate

in barrels. Few objects have a more offensive odor, or more of it, than a barrel of wet chicken feathers that has stood in a warm room for three or four days. If the plant does not possess a feather drier, the feathers, like all other offal, can be removed daily from the building in which the birds are dressed or stored. This the inspector should insist upon regardless of the necessity to save the feathers, or the difficulty of getting them carted away if they are not to be saved. A third method, less tried, is to treat the wet feathers with a solution of salicylic and benzoic acids, according to the directions for preservation issued by the U. S. Department of Agriculture.

The semi-scald and New York dress is fairly standard in the established produce field as is also the use of wax to remove the pin feathers. These methods are acceptable to the army. Because of the rapid labor turnover, unavoidable in a nation at war, many unskilled workers are employed even in the old, established plants. On this account, the inspector needs to give particular attention and adopt an unyielding attitude on temperature, tearing the skin in the automatic buffer, dropping birds on the floor, improper sticking, temperature of the cooling vat, delay in removing the birds to the cooler and similar matters, that would be handled properly by a skilled crew without supervision.

In the case of purchases of poultry from the new, local entrepreneurs in the produce field, the inspector must assume various additional duties. Mess officers and mess sergeants are an ever-changing group. Most of them are inexperienced in the poultry field and inclined to believe all an imaginative salesman tells them. The tendency to order so many pounds of "chicken" or so many cases of "eggs" is all but universal. The post commander requires that all organizations observe ceiling prices in their purchases. Since the veterinary service must stamp all invoices as accepted before they are paid, there is more or less constant wrangling on the part of peddlers over the changing of invoices to show the grade of the product and to conform to ceiling prices. For example, if the celing price of "fowl" is 34 cents on a given day and that of "roasters" is 38 cents; but if mature hens are supplied as "chickens" and invoiced at the roaster price, although the transaction may look all right on the dealer's books, the ceiling price is in fact not observed by a wide margin. These special messes are not spending government money, but their own, and the dealers know it and often resent it when the veterinary service determines to a considerable measure how it shall be spent and to an even greater extent where it shall be spent. This reduction in invoice prices will often amount to as much as a hundred dollars a week on the purchase of poultry and eggs alone and, coming as it does out of the net profit they had expected to make on the transactions, it puts the dealers in anything but a cooperative frame of mind. Thus the stage is set for recrimination when sanitary inspections are made.

It is the duty of the army veterinary inspection service to insure that foods of animal origin comply with contract specifications as to type, grade quality and manner of packaging, that they also comply with army regulations or regulations adopted by the Army for the processing of such food and with such special provisions, usually sanitary, as the responsible inspector may deem necessary to assure the wholesomeness and safety of the food product in any particular case. In practice this is accomplished, not by an unyielding rejection of every article that does not fully meet all specifications, but by a patient and sincere endeavor to induce all suppliers to comply with all the specifications. A different approach would speedily eliminate most of the local purchases by camps. These local purchases, on the whole, possess many advantages. But if there is any place where an unyielding stand is justified, it is in the matter of purchases from the "for the duration only" local dealers. The reason being their common reluctance to procure needed equipment or to make desirable changes in methods unless, and until, their products are abruptly rejected, pending such time as compliance in these matters is satisfactory.

To make material progress in improving the sanitation in such plants, the inspector

will have to insist upon a reasonably serviceable building, fully screened and having floors impervious to water and, at least, the following equipment: Three movable racks with a capacity of two dozen birds each, a scalding vat and thermometer, a cooling vat equipped with a cooling coil or

The inspector needs not only to explain, but to demonstrate the proper way to stick a bird, to obtain complete bleeding without getting blood on the head, the feathers, the carcass, the walls, the ceiling, the employees and perhaps the truck. He will have to demonstrate the way to paralyze the bird and

FIG. 36. SLAUGHTERING DUCKS IN A LARGE ESTABLISHMENT

(1) Awaiting the shackle and sticker. (2) Hung on the shackle and being stuck for bleeding. (3) Bleeding. (4) Endless chain that conveys the shackled birds through the various operations of dressing. (5) Blood trough. (6) Picked ducks in the cooling tank. When the internal temperature is reduced to 36° F., they will be hung on racks to dry and then wheeled into the cooler, to be sold either as "fresh chilled ducks" or packed in boxes and hard frozen, to await a more favorable market

a handy supply of ice, a smooth surfaced table of large size, a refrigerator room of sufficient size, sticking knives of proper size and shape, an ample water supply and means for heating water, floor drains, a separate room or stall for bleeding the birds, containers for feathers, plenty of artificial light and an exhaust fan of adequate capacity. Additional equipment is of course desirable. However, the above itemized equipment is essential, regardless of the wonderful job of dressing chickens the owner's wife or mother can do in her kitchen without any of it.

loosen the feathers and that hard scalding is unnecessary; to explain that tears in the skin mean additional contamination and are objectionable as are dirty feet also, and for the same reason. He will need to insist that killed birds be semi-scalded and picked (including pinning) promptly after they are killed, that they be cooled at once and, when the internal temperature has reached 36°F., taken, without delay, either into a chill room, the temperature of which is not above 34°F. or that they be hard frozen at once, if such is the plan. There must be no attempt to market birds as

chilled poultry and then, if they are not sold, freeze them to avoid loss.

Having stated the minimum requirements in equipment and the methods necessary to meet the Army standard for poultry and having given directions for maintaining sanitation in the plant similar to the sanitary requirements already enumerated for the larger poultry slaughtering establishments, enforcing his directives become the inspector's individual problem. In many instances it is a problem that will test his resourcefulness to the limit.

A particular instance, which is in no way exceptional, may illustrate some of the problems the inspector meets. A man and his family had operated a roadside fruit and vegetable stand on a much traveled national highway some six miles from a city of 60,000. He had prospered and in time built two wings into his building (which originally had been but a shack), and added a soda fountain and soft drink counter and a lunch counter at which he served sandwiches, principally hamburger. He equipped the place also with a walk-in refrigerator and a rather elaborate refrigerated show case. With the coming of meat-rationing, he added chicken sandwiches and rabbit sandwiches to the menu and soon began to retail dressed poultry and rabbits, advertising these new ventures by exhibiting several coops of live chickens and cages of live rabbits at the ends of his long low building. For his supply of poultry he rented an unused barn, that stood in a field some three-quarters of a mile away, and installed a poultry slaughtering unit in a lean-to hay shed.

When the acute shortage of poultry developed in the early summer of 1943, army mess sergeants began to search all about the district for sources of supply and the mess sergeant of a school mess happened

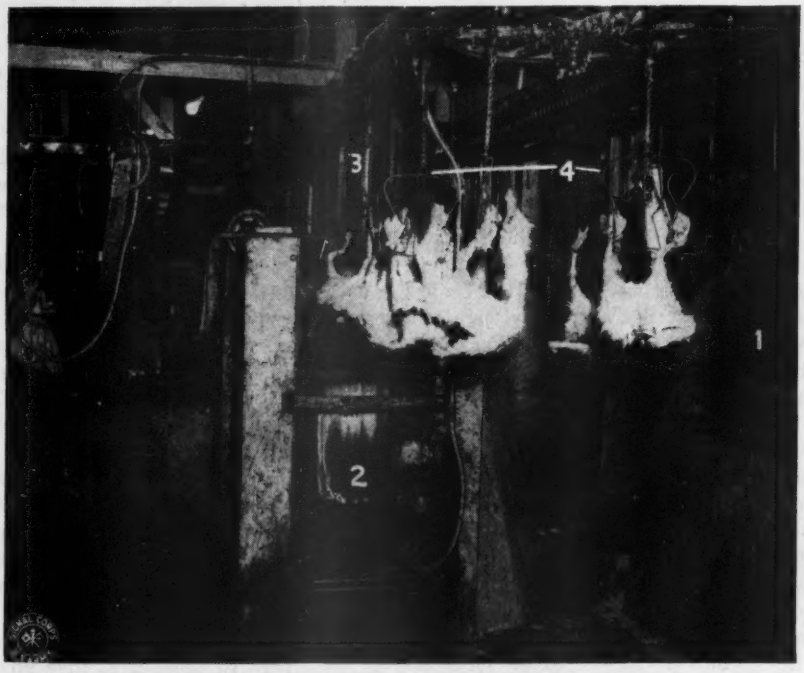


FIG. 37. SECOND VIEW OF DUCK SLAUGHTERING

These birds have been dipped in the scalding vat, have passed over (1) the buffer (automatic picker), where all body feathers have been removed. (2) Tank filled with warm wax. As a group of three ducks come into place directly above the tank, it is raised automatically to submerge them in the warm wax and then immediately returned to the position shown in the illustration and the ducks move on in front of the large fan at the left, which dries the wax (3). (4) Ducks after they are buffed and before they are waxed. Birds not eviscerated and with the head and feet left on the carcass are spoken of as "New York dressed"

on to this establishment. Being new to the job and not knowing that sources must be approved before purchases could be made, he arranged to take an army truck and pick up 600 pounds of chilled poultry the following Saturday afternoon. In due time the poultry was presented at the Post veterinary office for inspection. The sergeant was much crest-fallen when it was explained that approval of the establishment should precede purchase, and steadfastly maintained that the place where he got the poultry was really an exceptionally fine one and just jammed with the cars of city people who were there buying the same kind of chickens. Moreover, that unless he could use these chickens the mess would have no meat but bologna for Sunday dinner. Imagine the situation! Bologna when a fried chicken dinner had been promised! What a roar! and what a job of explaining for the sergeant! The fryers looked all right, except they were hard scalded, and were reluctantly accepted pending inspection of the plant.

The inspection of the place the following Monday revealed, basically, a good layout. The shed had a concrete floor and the barn afforded space for housing several hundred fowl, but there was a large hog lot surrounding the barn on two sides. The equipment was excellent but the methods were execrable. The bleeding, killing, scalding, picking and eviscerating (much of the trade at the roadside stand was in eviscerated poultry) were all crowded together, although there was ample space for separating these operations. There was no floor drain but an opening had been cut in the wall at the floor, beside the eviscerating table and through this the offal was tossed to a dozen rangey, half-fed hogs penned in the lot outside, as the birds were dressed one by one. At the end of the day's kill, a hose was turned on the floor and blood and feathers also were washed out through this opening to the hungry hogs that stood belly deep in an unbelievably stinking loblolly. The flies were as abundant as only such a hatchery could have produced and such an odor attracted. The birds were bled by cutting their throats and they flapped and struggled their lives away as they bled. There were feathers over everything, a two-inch layer on the scalding tank and nearly as many on the cooling tank. They covered the dressing table, the eviscerated fowl and were thick in the hair of the women employees. The temperature of the water in the scalding tank was 170°F.

The owner was anxious for approval of his establishment and readily agreed to:

1. Sweep down the cobwebs and whitewash the entire interior of the room and install screens.
2. Bleed and kill the birds according to the demonstration.
3. Reduce the temperature of the scalding water to 140°F. (It should be lower).
4. Build a stall in which to bleed the birds and separate the bleeding, scalding, picking and cooling operations some distance from one another.
5. Collect feathers and offal in barrels and remove them daily.
6. Move the hogs to a weedy hillside at least 150 yards from the slaughter house, cover the mud hole with sand and dig a narrow trench to carry away the waste water, and to put in a floor drain and tile to carry this water, as soon as he could arrange it.

All this, except putting in the drain which he thought might involve some difficulty, he promised to have done within a week or, at most, ten days; stating that he certainly appreciated being told what was needful—the inspector must come back again, and often, because, there might be other things he didn't know upon which pointers could be given.

About two weeks later the same sergeant called on the long distance telephone and said he was at the poultry plant, that all the changes suggested by the inspector had been made and was it all right to buy some more fryers—"the last ones were awfully good"—and bring them in for inspection? The answer was no, but if he was sure the sanitary requirements had been met, another inspection would be made—sources of poultry were scarce—wait an hour.

On arrival at the slaughter house the findings were so usual that they might be said to be routine.

1. The walls and roof (ceiling) had been whitewashed and the door and windows screened but two or three dozen knotholes

and spaces between the rafters at the top of the wall were open and the room contained twice as many flies as before.

2. New employees were operating as before. The bleeding stall had not been built because all the carpenters were busy.

3. The scald water was just under boiling and there were feathers all over the place.

4. An electric hog fence had been put up on the hillside but as no one could be found to cut the weed in the fence row that short circuited the current, the pasture could not be used.

5. The hogs were still feeding two feet from the eviscerating table. A man was coming to fill up the mud hole next Monday. The ditch-digger who was engaged to dig the drain had been sick but would be all right in a day or two. In another three days the dealer was positive everything would be fine, and of course since the other chickens turned out all right, and didn't kill anybody ha! ha! we would want these. And he was telling all his customers he was supplying the Army now and they were much pleased to know his poultry was so good, and any number of them had told him of dealers whose products had been refused by the Army because their places were really not as clean as they should be, and our birds would come right out of the cooler and did the inspector want them packed in ice (he didn't) or would he take them just as they were (he wouldn't) and on and on.

No further word was received from this dealer in three days—or ever—but indirectly it was learned that his roadside trade had increased until it absorbed his whole output. No doubt the demand for his poultry was stimulated by tales of his army business.

Such dealers are exceptional, but there are some who act on the principle that what the consumer doesn't know won't hurt him and, at first, refused to take seriously the army's sanitary requirements for food processing.

The following is a sample of a report of the sanitary inspection of a produce plant of larger than the average size. More detail concerning the egg department of the establishment should have been given and approval or disapproval of it as a source of eggs also would have increased the value of the report and placed on file information that later might be useful to the Army.

FIG. 38. THIRD VIEW OF DUCK SLAUGHTERING

(1 and 3) Removing the hardened wax which carries with it every particle of down from the dressed birds. (2) Emptied shackles ready for more live ducks. Pinfeathers are removed from chickens in same way

Report of Sanitary Inspection of a Poultry and Egg House

1. *General:* This establishment is located in the business district of ————————. It procures and merchandises eggs and poultry of which a good portion is distributed to army installations. On a much smaller scale, butter, fish and some frozen vegetables and fruits are distributed, but not to the military personnel.

a. Building: The building is a two-story brick structure. The first floor contains: the rooms for poultry slaughter, egg candling, two coolers and an office. The second floor contains: one freezer, one room for live poultry, toilet, and some miscellaneous storage space.

b. Interior Construction of Building:

(1) Walls and ceiling: The walls of the first floor are finished in new plaster and painted. The walls of the second floor are not new but are in good condition. The ceilings are also in good condition.

(2) Floors: The floors are of cement construction and in good condition. The floor in the slaughter room is sufficiently pitched to a drain.

(3) Windows: The windows are insufficient in number to give adequate light or ventilation, but are screened.

(4) Doors: The doors of the slaughter and live poultry rooms are not screened.

2. *Equipment:* The equipment in the poultry processing room consists of: a wire rack on which poultry is hung for bleeding, one scalding tank, a table and a double cooling tank. The equipment is meager but sufficient.

3. *Slaughter:* This procedure was very indifferently done with apparently no thought as to the final condition of the birds.

a. Bleeding: The poultry are hung on the bleeding rack, the throats are cut and a large portion of the slaughtered birds are not permitted to hang long enough for proper bleeding. The birds, some still flopping, are then dropped on the blood and water soaked floor and remain there until ready for scalding.

b. Scalding: The birds are immersed in water at 150 to 160°F. for irregular periods.

c. Buffing and hand picking: The buffing process is carried to extreme, which leaves the birds badly marked. After the hard buffing, picking is required only for the wing tips and some tail feathers.

d. Hot water dipping: After picking, the birds are dipped in a tank containing water at a temperature of 190°F. or higher, the purpose being to increase the bloom.

e. Chilling: Tap water, at a temperature ranging from 68 to 75°F., is used for chilling. The birds are immersed in this water from one-half to one hour.

4. *Cooler Room:* The cooler room is adequate except for the lack of a thermometer. The temperature of the room was estimated to be about 40°F. at the time of the inspection.

5. *Insanitary Practices:* The entire slaughtering process is carelessly and indifferently performed with no attempt at sanitation.

a. Most of the birds are not left on the bleeding racks long enough to permit sufficient bleeding. A considerable percentage are poorly bled.

b. The slaughtered birds are dropped on the floor before they are scalded. At the time of inspection some birds on the floor were still flopping.

c. The water in the chill tanks is not cold enough to properly chill the freshly killed birds.

d. The cooler room has a very foul odor resulting mostly from the dirty floors and racks. Some of the odor is from birds that had been kept in the cooler until they were in an advanced stage of putrefaction.

e. There are no screen doors to the slaughter room, which opens directly onto the sidewalk. Neither does the live poultry room have screen doors. At the time of inspection there were many house flies and maggot flies in all the rooms.

f. On the day of inspection, frozen fish, which is not handled regularly, were being thawed in boxes adjacent to the crates containing live poultry. The top layers of fish were partially thawed and covered with flies, many of them *Musca vomitoria.* The fish were not intended for sale to the Army. These fish were old storage fish and decomposition had started in a large percentage of them. The filleting was done in the poultry slaughter room. The dressed fish were placed in a barrel, which was overflowing to the same drain as the poultry slaughter, where the bled birds were dropped.

6. *Recommendations:*

a. That screen doors be put in the slaughter and live poultry rooms.

b. That slaughtered birds be adequately bled before scalding.

c. That birds be left on the bleeding rack until ready for scalding.

d. That a complete and regular clean up of slaughter room, cooler, and cooler racks be made.

e. That ice cooled or refrigerated tanks be used so birds may be promptly chilled to an internal temperature of 36°F.

f. That strict sanitary practices be maintained in all aspects of slaughtering poultry.

g. That the use of the hot tank between the scalding tank and cooling tanks be discontinued.

h. That more expert and efficient help be employed under better supervision.

i. That this establishment be disapproved for the supply of dressed poultry and fish to the Army pending compliance with the foregoing recommendations.

1st Lt., V.C.

Shell Eggs

The sanitary requirements for establishments handling shell eggs are less exacting than those for most other foods, not because eggs are not subject to contamination but because of the protection afforded by the shell, and because common practices are not so conducive to new contaminations, as they are to the growth of bacteria already present in or on the egg; i.e., the temperature is more important than the environment of the egg.

In making an inspection of an establishment supplying eggs to the Army and the methods of handling them, the inspector will want to assure himself, in the matter of fresh eggs, that they are collected promptly from the producer, that they are held under proper temperature and humidity control, that grossly dirty eggs and eggs with cracked shells are not included, nor are washed nor sanded eggs included and finally that the dealer has proper facilities and competent personnel to grade and candle them. It is useless for a dealer to contract to supply eggs to the Army if he can't comply with these conditions, since, his shipment would be rejected to his cost and the inconvenience of the Army.

Eggs deteriorate rapidly from heat and lack of moisture, also from molding when the humidity is too great and are injured by the shaking incidental to transportation. Fresh eggs withstand all unfavorable influences better than older eggs and unless improperly stored they will meet army requirements better when less than two weeks old. Thus there are important advantages in procuring eggs for an army camp from a local supply. Transportation is saved, the eggs are obtained sooner after they are laid, the injury from transporting them long distances is avoided and if a shipment is rejected the dealers' loss is less. Other things being equal it is about as easy to supply a local camp with eggs that grade U. S. procurement II as it is to supply U. S. procurement III to a camp 1000 miles distant. There is a great deal of difference in the relish with which these two grades of eggs are eaten and in the waste as well.

Contrary to the rule in food procurement, the Army is likely to obtain the highest quality eggs from the smallest dealer. Within a 25 to 30 mile radius of most army camps there are a few to several chicken farms that produce three to a dozen cases of eggs per week; enough to supply various

Fig. 39. Egg inspection by student veterinary officers, War Department School of Meat and Dairy Hygiene, Chicago

of the special messes and some of the demand from the Post Exchange. It is astonishing how easily and quickly farm children from eight to 12 years of age can be interested in collecting and holding these eggs properly, until the weekly market day, and how quickly they can be taught to candle and grade them. They take a consuming interest in supplying eggs for the soldiers and turn out a far more uniform product than their blasé brothers and sisters of high school age will do when employed in a dealer's establishment in town. The veterinary inspection service can well encourage this local source for eggs for the special messes.

Egg Powder

Eggs excel all other foods in the universality of appeal to the appetites of soldiers. Only ice cream, which the Army uses as a dessert, is distasteful to so few in the armed services. Shell eggs, and scarcely less, frozen eggs are bulky and costly to transport and both are promptly rendered unfit for use if they are not refrigerated. When the difficulty inherent in transportation of shell eggs to troops in far distant lands and in the maintenance of refrigeration until they reach troops in the field are considered, it is not surprising that the demand of the Army for whole egg powder, a more stable and less bulky form of eggs, exceeds even the recently greatly augmented capacity of the industry. The prewar production of egg powder averaged about eight million pounds per year. The estimated production for 1943 is 400 million pounds. Egg powder represents but 25% of the weight and 20% of the bulk of the shell eggs from which it is made.

The sanitary requirements that must control the processing incident to the manufacture of whole egg powder for army use are exacting at best and, because they differ so greatly from the requirements for egg powder entering the channels of ordinary commerce, their attainment is particularly difficult. Egg powder manufactured for bakers, ice cream manufacturers and confectioners has long been a by-product or sort of salvage product of the shell egg industry. By means of freezing them and later manufacturing egg powder from them, undersize, cracked, checked, partially evaporated and many other eggs not suitable for the shell egg trade were salvaged and used by bakers and others in the preparation of food products for which they were regarded as suitable. Because they could be stored at a low temperature until used, or used in highly flavored products, the heavy contamination, unavoidable under the conditions of manufacture, gave little trouble. Because egg powder for the Army must, at least for days or weeks keep without refrigeration, perhaps exposed to desert heat or tropical warmth and humidity and because it must be capable of reconstitu-

FIG. 40. EGG CANDLING MACHINE

(1) Egg tray by which three dozen eggs are picked out of an egg case as easily and almost as quickly as one egg can be picked out by hand. (2) Eggs on the starting table. This is an endless slatted canvas (3) which moves slowly dropping the eggs off at the far end onto another moving canvas which conveys them in a single row (4) through the dark stall shown in Fig. 41

tion for table use as scrambled eggs and therefore cannot be sterilized by heat, the difficulties of avoiding contamination in manufacture constitute an acute sanitary problem for the Army veterinary service.

The sanitary control of egg powder manufacture for the Army should be similar to that for the processing of fluid milk, but more rigid, since the eggs are not pasteurized as is milk. Further egg meat is more favorable to the growth of bacteria than is milk. At 40°F., the increase in the number of bacteria in egg meat is rapid, at 45°F. it is enormous and finally egg shells are usually heavily contaminated with enteric and other organism. Whereas a thorough clean-up once a day is adequate in a fluid milk plant, utensils inconstantly used in an egg powder plant should be cleaned and sterilized each time they are used. Those in constant use should be treated similarly, in most instances hourly, and no case at longer than three or four-hour intervals.

The inspector will need to insure that only shell eggs of good quality are used in the manufacture of egg powder; that they are thoroughly chilled to 29°F.; that they are removed to the breaking room within 15 minutes from the time they are taken from the cooler; that the temperature and humidity of the candling room and of the breaking room are not such as to cause visible drops of moisture to collect on the shells. The temperature of these rooms should be not higher than 60° F. and a lower temperature is preferable if it does not interfere with the work. The employees in the breaking room should wear clean, white uniforms and caps or hair nets, the breakers should wash their hands frequently—at not longer than half-hour intervals. The eggs should be broken in small

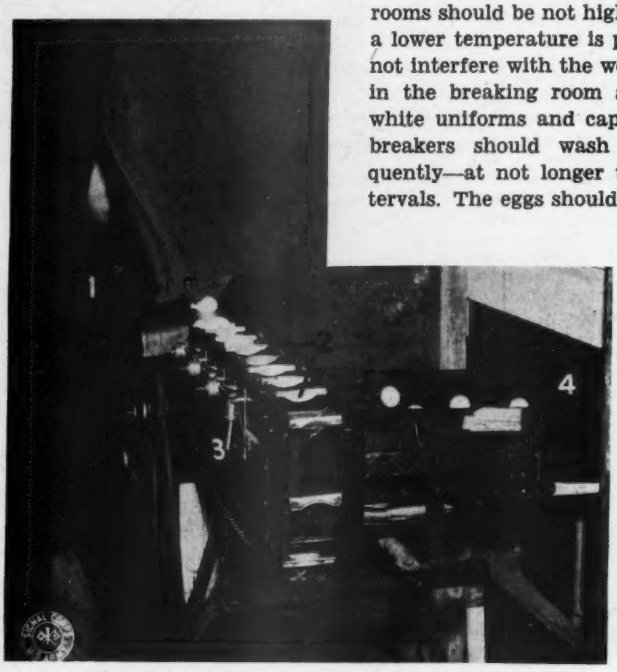


FIG. 41. SECOND VIEW OF EGG CANDLING MACHINE

(1) Operator who picks out rots, meat and blood spots, stuck yolks and leakers. Normally he is completely enclosed and has no light but that under the row of eggs passing before him. In the illustration the curtains have been drawn apart to show him (not very successfully) at work. In passing through the "dark room," the eggs roll upon spools that slowly turn them thus giving the operator an all around view of the egg. (2) Delicate electric egg scales motivated by mercury switches. Coming through the candling stall the eggs are rolled onto these scales in succession. When an egg of a size weighing 28 ounces or more to the dozen is rolled onto the first scale, it turns sidewise and drops the egg onto a canvas conveyor which rolls it to the right into a compartment for large eggs. Lighter eggs roll on to the next scale which is tripped by eggs weighing 26 to 28 ounces per dozen. The third scale drops eggs weighing 24 to 26 ounces, the fourth 22 to 24 ounces and eggs weighing less than 22 ounces per dozen roll into the last compartment. From the various compartments they are put into separate cases and are ready for market, for holding or for processing and storing. Machines of this sort are rarely used; they save labor, particularly skilled candlers, but their work is less satisfactory than good hand candling

cups and each cupful tested for off odors before it is emptied into the container for the egg meat. When a cupful having an off-odor is discovered it should be discarded and the cup and breaker knife removed from the room for sterilization. And the breaker should wash her hands and rinse them in chlorine solution and procure another sterile cup and sterile breaker knife.

The eggs from the breakers should be collected in sterile pails, strained to remove small pieces of shell, churned, pumped through a filter and stored, pending drying, at a temperature not above 30° F. within a half-hour from the time they entered the breaking room; their temperature should not rise above 45° F. at any time between the cold storage and the egg sprayer.

Army contracts provide that egg powder will be manufactured only by the spray process. By this process the liquid egg meat is forced, at high pressure, through nozzles into a tower (or box) into which a great volume of hot air is blown. The fineness and quantity of the egg spray and the temperature and volume of hot air must be carefully adjusted to (1) reduce the moisture content of the resultant powder to 5% or less, (2) avoid coagulating the albumen and (3) avoid scorching the egg powder. Since albumen coagulates at 130° F., egg powder scorches at about 150° F. and the temperature of the air used for drying is usually about 285° F., and sometimes as high as 350° F., a delicate balance is required. If the moisture content of the powder is 6% or above it tends to collect in lumps and its keeping qualities are greatly lowered. If albumen is coagulated or the powder is scorched, its solubility (reconstituting quality) is negatived and its palatability lowered.

The egg powder should be collected from the drying tower at frequent intervals, sifted to break up lumps and to remove any coagulated albumen, cooled promptly, packaged and stored at a temperature not above 50° F., although it will keep for some

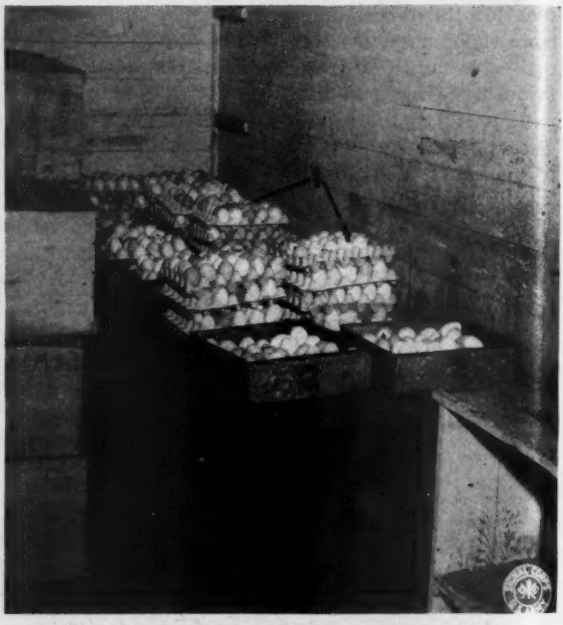


FIG. 42. REJECTS FROM CANDLED EGGS

(1) Checks. (2) Leakers. Eggs shells are subject to checking and to breakage, by the hens that lay the eggs, the farmer who collects these from the nest, the trucker who hauls them, in the produce house, in the retail market and while being delivered to the consumer. Checks are acceptable on the fresh-egg market in all but the best grade, if the percentage of them is not too large. They are not suitable for storage because of the loss due to mold, the spores of which are always to be found on egg shells. They should not be used for egg powder on army contracts. Leakers are marketed for cooking (bakers' eggs) either fresh, frozen or as egg powder. The army will not accept leakers for any purpose (except that a tolerance is allowed for a small percentage, presumably, broken during delivery). Egg shells are always well seeded with enteric (and other) bacteria including coliform and usually Salmonella also. These are dangerous organism and as the meat of the broken eggs is contaminated within a few hours by millions of organisms per gram, their use, even in cooking, is regarded by army inspectors as objectionable. Food poisoning from eating confections is rather frequently reported. Confectioners' products commonly contain leakers. How often this egg material is the source of Salmonella or Staphylococcus poisoning, or whether it ever is, is unknown, but the possibility that it may be responsible, justifies the veterinary inspection service in rejecting all broken eggs

period at temperatures up to 80° F. At temperatures higher than 80° F. the palatability of the product deteriorates rapidly. Cooling egg powder without further contaminating it offers considerable difficulty but should be accomplished (temperature reduced to 80° F. or lower) within 12 hours and better still a shorter period from the time it is sprayed, when it may be packaged and stored at not above 50° F.

If liquid egg is to be held for more than a day or at most two days before it is dryed, it should be quickly and solidly frozen and when ready for drying quickly thawed, broken up, thoroughly mixed and sprayed before the temperature of any part of it has risen above 40° F. This requires careful planning.

The bacterial content of liquid egg is reduced greatly in the spray tower and that of the powder decreases further during the first few days of storage. However, both reductions are percentage, not absolute, reductions and the greater the bacterial content of the liquid egg, bacterial flora being the same, the greater the bacterial content of the finished powder.

The manufacture of egg powder presents no unique problems of sanitary control other than those mentioned in the foregoing. Otherwise the general sanitary provisions that should govern the processing of fluid milk are adequate. It is perhaps

FIG. 43. EGG BREAKING

(1) Case of eggs ready for breaking. (2) Breaker knife. (3) Organoleptic test. (4) Cans for egg meat. (5) Egg strainer. These eggs are being prepared for freezing for commercial, not for army, use. The operation is subject to much criticism and would not be accepted by the Army veterinary inspection service. The wall on the left is not clean, not even capable of being cleaned; egg cases should not be taken into the breaking room, much less stored there as, in this case, an increase in mold contamination of the atmosphere and of the egg meat is certain by this means. There is far too much "junk" stacked about, nothing but what is needed, should be allowed in the breaking room; visitors are included among the non-essentials. Egg cups of a fourth breaker are left in the room, instead of being taken out and sterilized when she quit work. The egg strainer is too elaborate, not likely to be cleaned and sterilized hourly. One of the girls is wearing street clothes; none has the hair properly covered. No hand washing facilities are observable. The short sleeves may indicate that the room is unnecessarily warm, and finger rings, are objectionable on an egg breaker. An inspection of the room would probably reveal many other faults, possibly all, like those mentioned, easily correctible

worth repeating, however, that eggs are more susceptible to bacterial change than milk and, furthermore, the palatability and solubility are lowered by chemical changes that occur on exposure to the air—quickly when the egg meat is warm.

Dirty eggs should not be used for egg powder but they sometimes are so used. If used at all, they should be washed in a 1% lye solution and rinsed in a chlorine solution, both liquids of the *same* temperature, not lower than, nor more than 5° F. higher than, the temperature of the eggs. The eggs should be dried without wiping and taken to the breaking room within the time prescribed for all eggs.

By way of comment, it may be mentioned that no one has yet explained why the egg shells are discarded in making egg powder. Except for the calcium content of milk, eggs closely approximate that "most nearly perfect food" in nutritive value. Recent research in nutrition has indicated, if not definitely shown, that a considerable portion of the population of this country is constantly on the borderline of calcium deficiency. Egg shells are calcium in just about its finest and most assimilable form. They could be sterilized and ground to a flour, easily, and added to the egg powder as it is sifted. Instead, hundreds of thousands of pounds of this valuable mineral constituent of food is used for animal feed or (as is commonly the case) trucked away to be spread upon "sour" fields to "sweeten" them, and the egg powder is consumed without this sole constituent, that is required to make it a nearly complete food.

FIG. 44. EGG INSPECTION AT AN ARMY POST

When a consignment of eggs is offered for sale to the Army, the veterinary service selects 5% of the cases for examination and candles 100 eggs from selected layers in each case. Although this comprises less than 2% of the whole number of eggs in the consignment, it indicates with remarkable accuracy the grade of the whole. If the eggs are honestly packed or if they are not so packed, this also is revealed. If any doubt exists after examination of the 2% the inspection is continued until it is determined definitely that the eggs do or do not meet contract specifications. Small tolerances are allowed for low grade eggs missed by the contractor in candling. Theoretically, if any part of a consignment is unsatisfactory the whole is rejected. In practice the seller is usually given the option of replacing the unsatisfactory product. Since an army containing 40,000 troops will consume from 800 to 1,000 cases of eggs (288,000 to 360,000 eggs) weekly, the inspection of them requires many hours a month for two or more members of the veterinary detachment. However, this expenditure of time is well worthwhile because eggs lacking in palatability are a total loss in an army mess